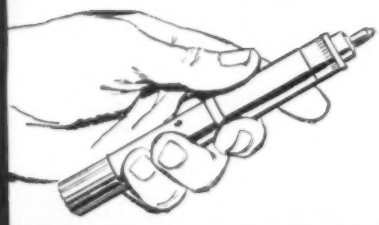
the

TOOL ENGINEER

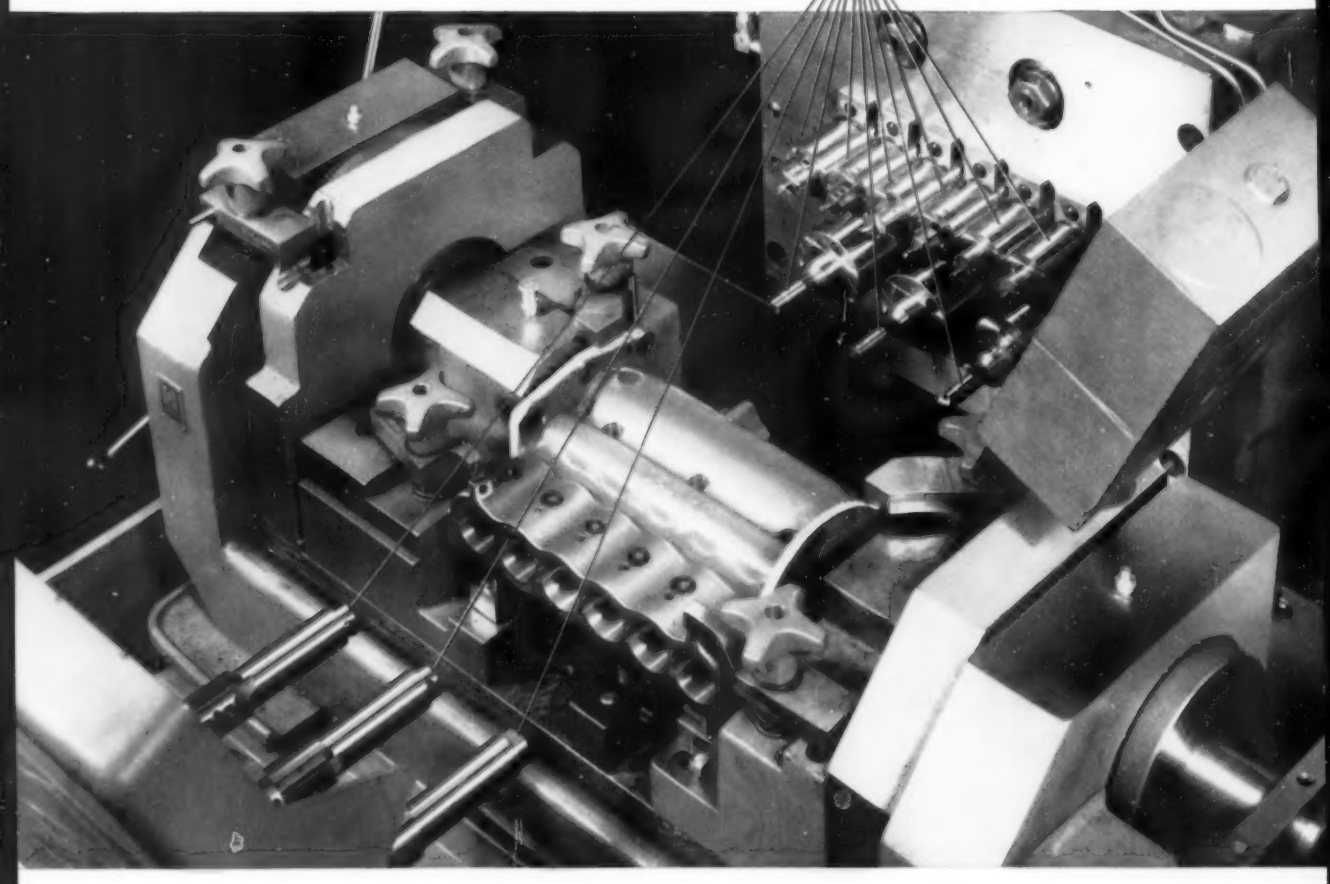
AUGUST 1960

cold hobbing

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS



12 HEADS
are better than one



Heald Bore-Matic finishes up to 27 DIFFERENT SURFACES at a single loading

• In the setup shown above, 27 surfaces of 15 bores are done on one machine at a single loading—a Heald Model 222 Bore-Matic with Multi-Spindle heads with a trunnion type fixture. Six deep 3-step bores are done with the three left-hand heads with only one index of the cross slide. After indexing the fixture to hold the work vertical, nine right-angle bores are done at a single pass with the right-hand heads. The same machine also handles four-barrel pump housings, simply by removing one of the left-hand spindles and three of the right-hand spindles.

On multiple-hole Borizing jobs such as this, interchangeable Multi-Spindle Red-Head boringheads permit many operations to be combined on a single machine, with minimum indexing of the work and positive spacing between bores. Your Heald engineer will be glad to give you complete information.

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the tool engineer

Vol. 45, No. 2
August 1960

Creative Manufacturing IS TOOL ENGINEERING

Eliminating Secondary Operations—Short Cut to Greater Efficiency ..... *By Leslie Hoffman* 35
Performing all operations on a stamping—including hole sizing and countersinking—on one die saves time and improves hole accuracy.

Gadgets 38
[illegible]all transmits right-angle motion . . . fixture for grinding special punch p[illegible]ts . . . holder for turning rectangular blocks . . . quick-change gears.

Extrusion Hobbing Forms Intricate Cavities ..... *By W. E. Zimmerman* 41
Small electronic parts with internal fins are being cold-extruded. Production rates are high and surface finishes are excellent.

High-Production Job Shop—A New Concept in Manufacturing ..... *By T. W. Black* 45
With the versatile machines, tools and equipment available today, mass-production efficiency is possible in job-lot production.

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Manufacturing planning—processing—consists of six necessary steps. These are described and illustrated by the authors.

Increasing Tap Life ..... *By Howard C. Noll* 76
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How To Apply Pneumatic Power—Part 2 ..... *By H. L. Stewart* 77
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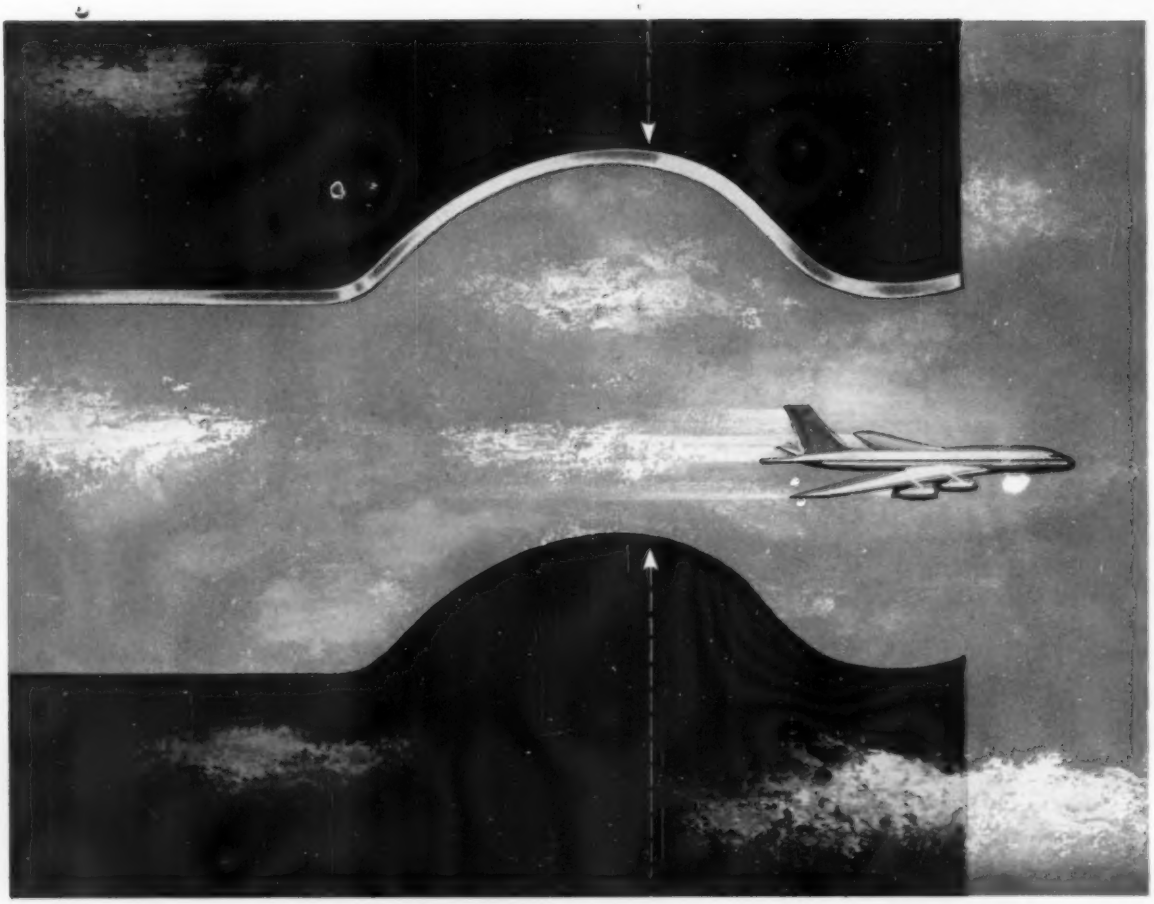
THIS MONTH'S COVER

Cold extrusion hobbing, in which a cavity is formed by forcing a shaped tool into the workpiece, is nothing new to diemakers but, as shown in the article starting on page 41, this process is now being used for production jobs. Cover artist William Solms has shown the completed workpiece an instant after forming. The cavity, with its intricate fins, requires no subsequent machining.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index*. The magazine is available to libraries and other institutions in microfilm form.



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The Miracle of Obsolescence

Many of us confuse obsolescence with age. We are often prone to use the words synonomously. This carelessness has led us to regard a machine of a certain age—say 5, 10 or 15 years—as obsolete. We know there is only a vague relationship between age and obsolescence, yet we persist. Is it because we feel obliged to give a number to everything in order to qualify as an engineer?

More probably the loose use of the word stems from confusion with tax allowances for depreciation. Obviously, the Department of Internal Revenue has placed values for depreciation, in terms of years, on machine tools and equipment in order to have a yardstick or common denominator for the purpose of determining taxes.

That yardstick is based largely on the life or, in other words, wear-out date of the machine rather than on the nebulous factor of relative productivity which, in reality, is what should be measured to include allowances for obsolescence.

When another machine can be more productive—that is produce better, cheaper or faster — the first machine has become obsolete. It is as simple as that. Yet in most cases it is almost impossible to predict when a machine will reach that point. Some are obsolete before they are built or before they are put into production. Others may be as modern as the day they were built after 10 or even 20 years of service.

One of the most important contributions of shows such as the ASTME Tool Show and the forthcoming Machine Tool Exposition in Chicago in September is the display of new machines in operation. The visitor can readily calculate the degree of obsolescence for each of his machines in his plant by comparison. This type of analysis is dependable. In fact, it has accounted for much of our industrial growth.

Instead of deploring obsolescence, tool and manufacturing engineers realize that progress depends upon the frequency or speed with which we can develop better processes and methods as well as designs. Our standard of living depends upon such growth. The sooner this fact is generally appreciated, the quicker will better machines be built and the more widely will they be applied. It is not enough to develop better machines for display at expositions. Follow through of application is an economic necessity if we wish to maintain leadership.

John W Greve

EDITOR

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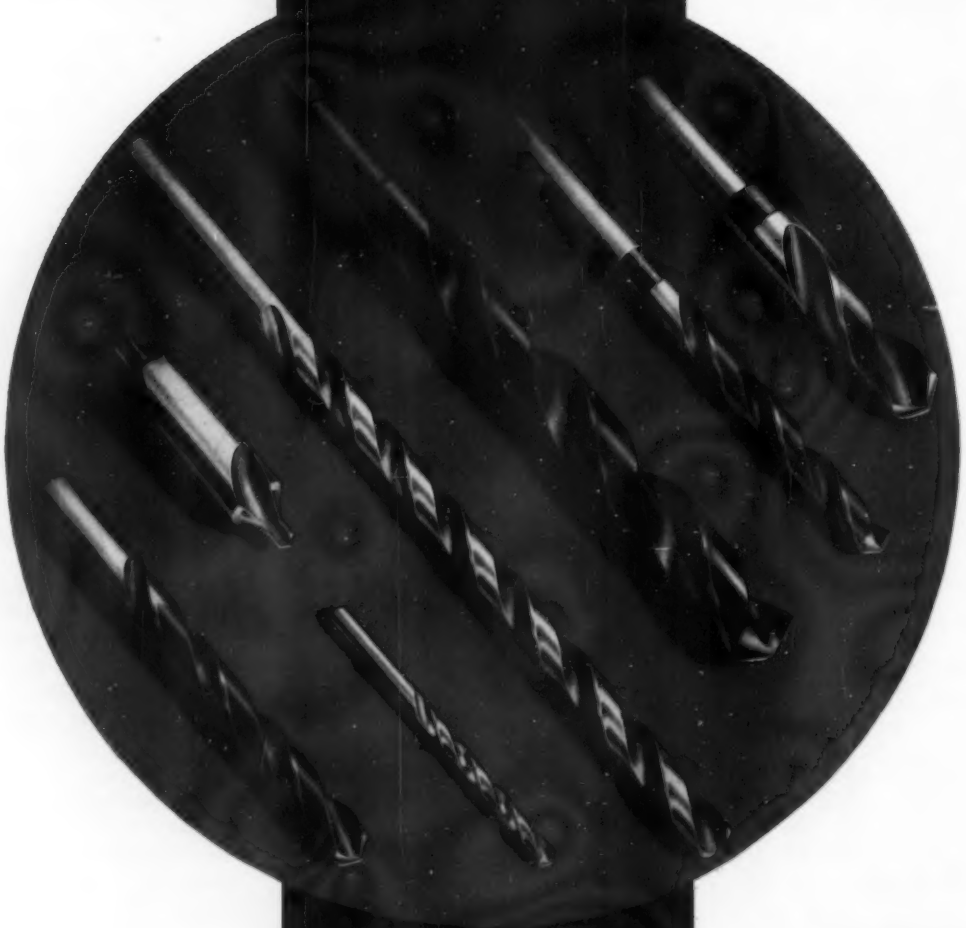

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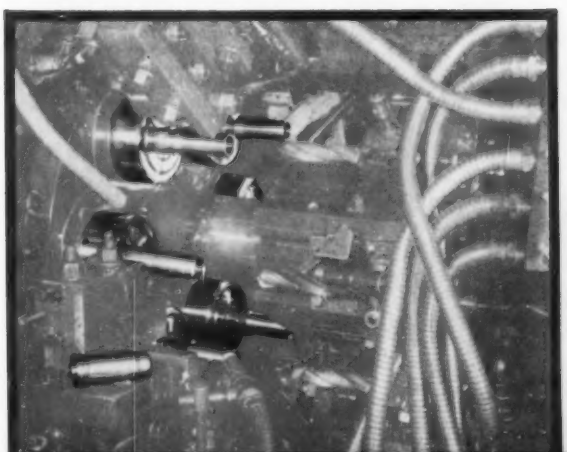

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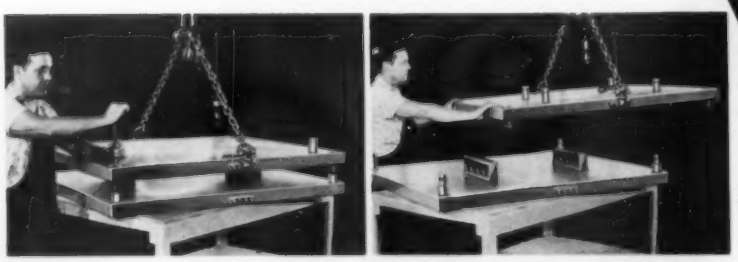

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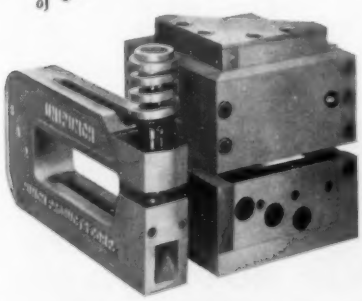

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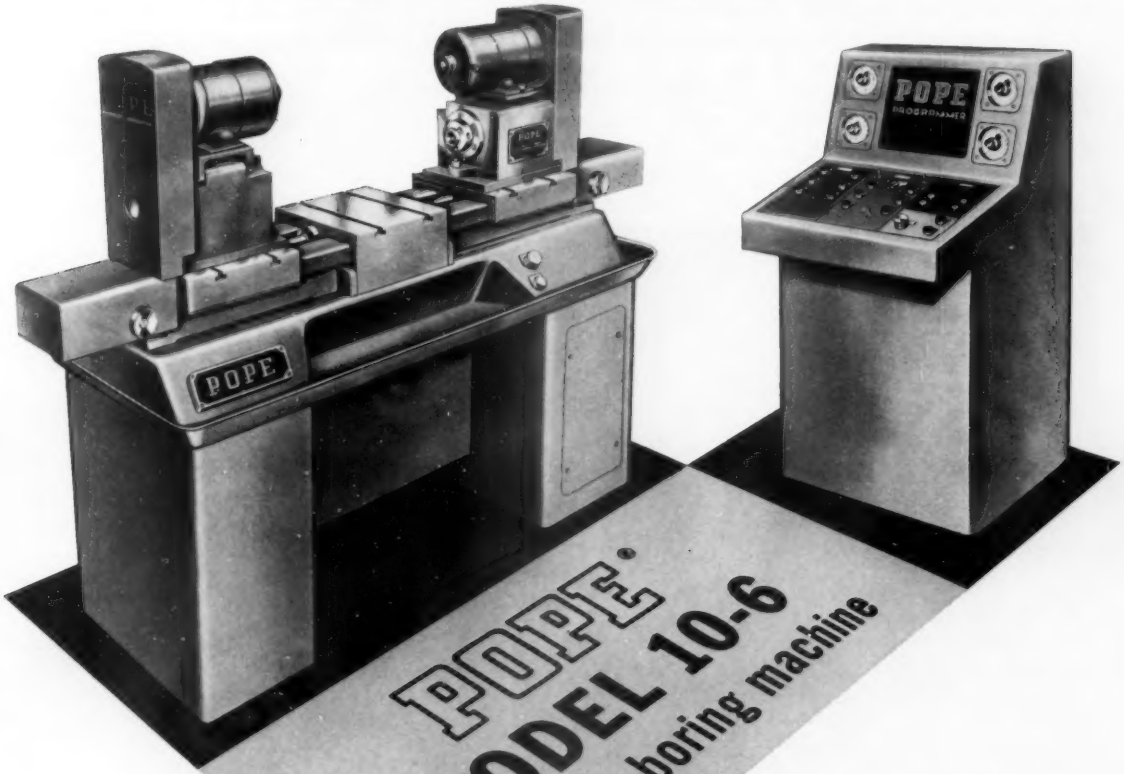

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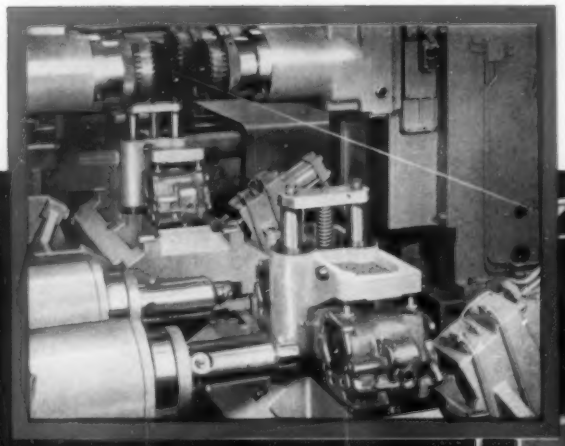
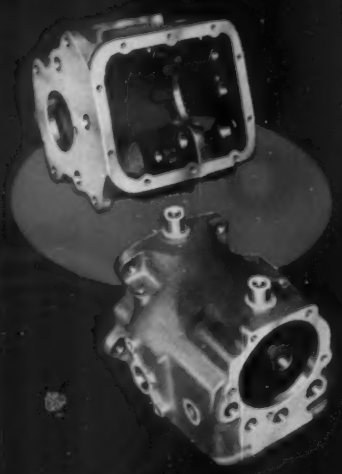
Many Unusual Features in New Transfer-matic for Machining Transmission Cases



Finish boring the front and rear main bores with one bar to assure concentricity.



Operations include boring the main shaft, counter shaft, reverse idler, and two shifter rod bores and precision facing both ends.

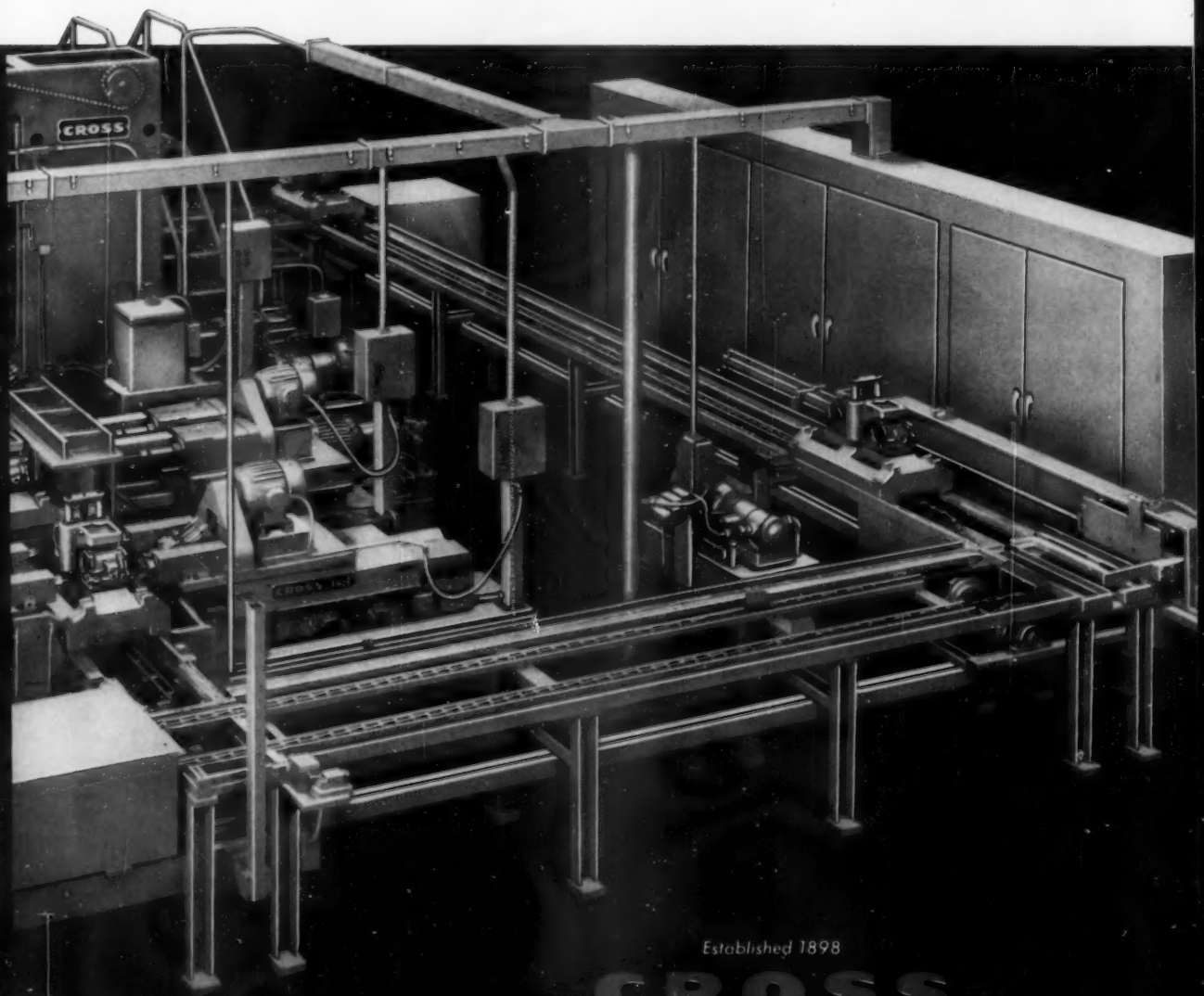
Another Automation First by Cross

An unusual new Transfer-matic which applies the production economies of automation to high precision finishing has been designed by Cross. It bores and faces transmission cases at a rated capacity of 140 parts per hour despite the rigid accuracy.

Some bore sizes are held to tolerances of plus or minus 0.00035 inch and chordal dimensions between three holes are held within plus or minus 0.001 inch. Squareness between the ends and bores is maintained to 0.0005 inch. Surface finish specifications are 56-110 micro-inches, rms.

A number of special features have been developed to assure this high precision. Center bases and wings are integral to obtain the rigidity necessary for maintaining precision alignment. Pallet locating is designed to assure extreme accuracy from station to station. Strategically placed air jets check the position of the pallets in each station.

A Cross sales engineer will be glad to explain details of this unusual Transfer-matic and other Cross innovations.



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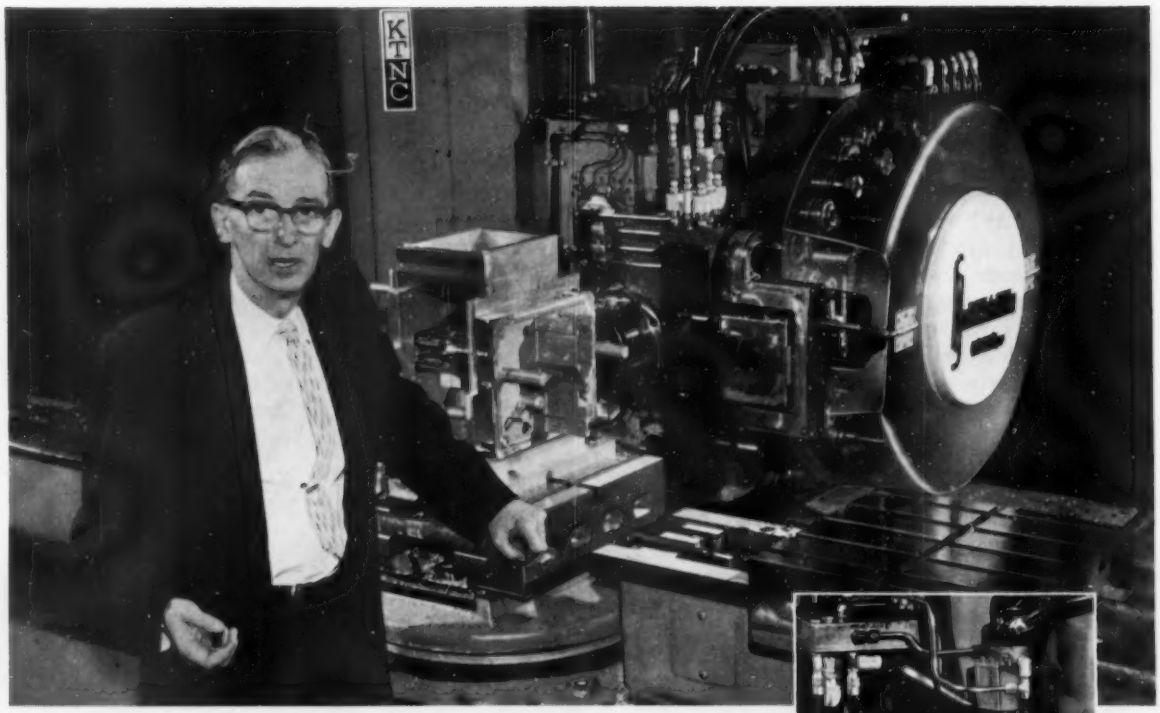


Mr. Julian Kerlin, Field Service Engineer for Kearney-Trecker Service Division, explains the contribution of Micro-Fog Lubrication to MILWAUKEE-MATIC reliability and ease of servicing.

Norgren Micro-Fog® Lubrication gives Kearney & Trecker greater flexibility in machine design

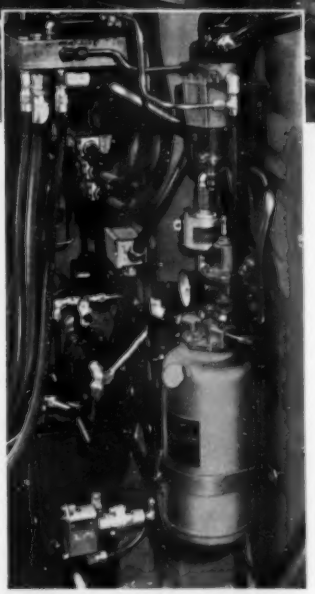
The new Kearney & Trecker tape-controlled MILWAUKEE-MATIC is an outstanding example of flexibility in modern machine design. In a single machine, the MILWAUKEE-MATIC performs all the operations of milling, drilling, reaming, tapping and boring that usually require several machines.

The Milwaukee-Matic is designed for maximum "chip time" and minimum set up and down time. This requires high reliability of operation and provision for rapid servicing.

This is why Kearney & Trecker engineers chose **Norgren** Micro-Fog for the lubrication system.

The Micro-Fog centralized air-borne lubrication system gives constant, reliable, metered lubrication at each bearing point. Alarm devices are connected to the control system of the machine to give warning of conditions affecting proper lubrication.

Micro-Fog is conducted to all bearing points through tubing, eliminating the need for cumbersome and costly return piping, oil filters, sumps and pumps. The result, as Kearney & Trecker found, is a wider latitude in machine design. With **Norgren** Micro-Fog, they were able to make maximum use of unitized construction in the MILWAUKEE-MATIC, providing for fast disassembly and component replacement.



This Norgren Micro-fog Lubro-Control Unit provides lubrication for the bearings on Kearney-Trecker's MILWAUKEE-MATIC, and for the slides, ways, gears and clutches in the head.

If you design machine tools which require measured, reliable lubrication of bearings, gears, slides, chains or ways, and want greater design flexibility, it will pay you to investigate Norgren Micro-Fog Lubrication. Write for detailed information, or call your nearby Norgren Representative listed in your telephone directory.

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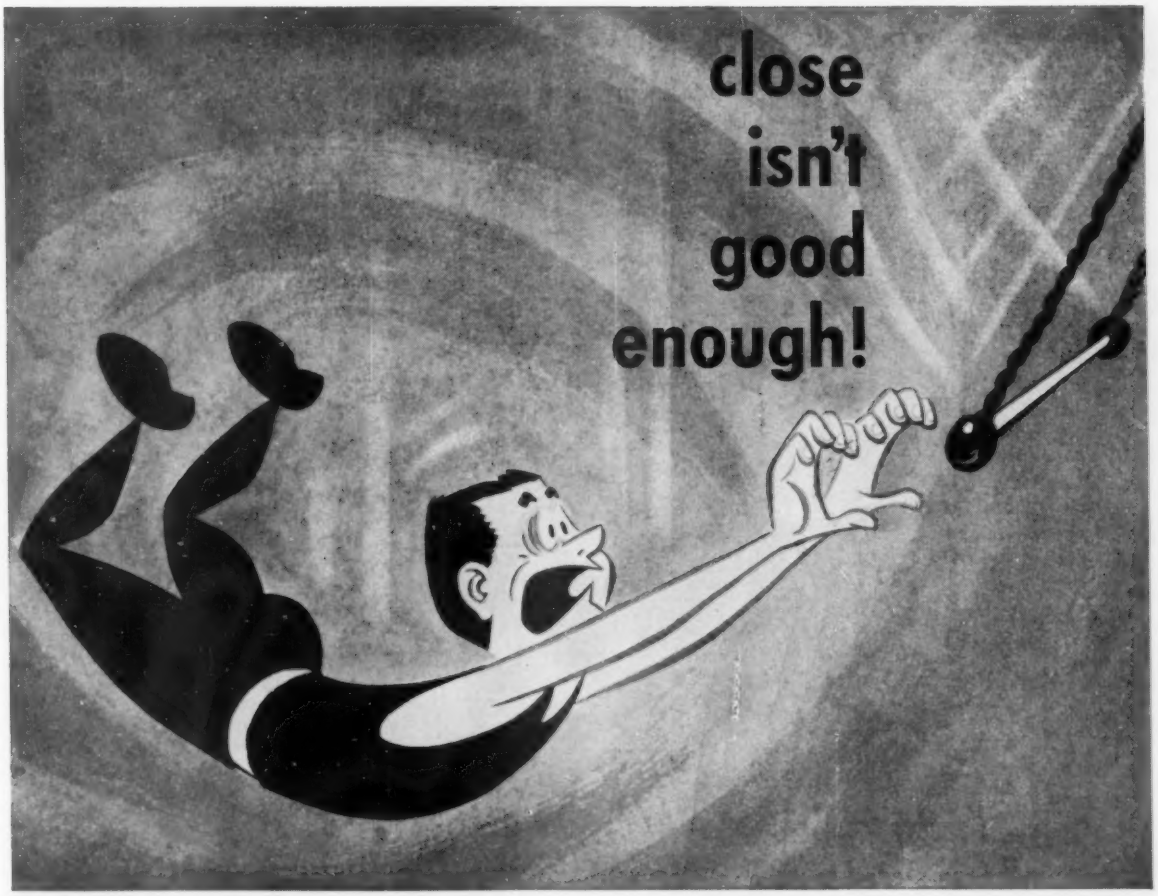

How close do you specify balancing tolerances for your rotating parts? Are they close enough? Can your balancing equipment meet them accurately, quickly, or do you depend on your operator's judgment? It's worth knowing because it costs far less to balance precisely than to correct product failures and regain lost customer confidence once a breakdown occurs "in the field."

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TO HELP YOU SPECIFY the balancing equipment best suited to your needs, Gisholt offers a general balancing catalog that gives a frank discussion of the problems of balancing of rotating parts. All methods currently used (mechanical, optical and electrical) are covered in detail. For your free copy, call your Gisholt Representative or write.

This Gisholt 1S Balancer is used to locate and measure unbalance in Dynamotor armatures. The direct reading amount meter is calibrated so that one meter unit equals ⅛" length of ⅛" diameter solder. Work is corrected in left and right correction planes, using simple soldering iron, and rotated again to inspect for balance. Production—by the female operator shown—over 40 parts per hour.

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CREATIVE COST CUTTING

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Small spring clips between telescoping parts of auto radio antennas must maintain electrical contact, hold parts firmly, give smooth sliding action. Brach Manufacturing Division of General Bronze Corp., Newark, N. J., found that spring clips of Duraflex®, Anaconda superfine-grain phosphor bronze, gave best positive electrical contact and improved smooth action in Brach Auto Antennas over original clips made of premium metals. The clips stand up in constant use, spot welding and fabrication are easier—and costs are about 25% lower.

In this G-E Automatic Coffee Maker control, a thermostat turns cam actuating switches—for high heat to brew coffee, for low heat to keep it warm. At first, upper switch element was an assembly of blade, bushing, and locking nut. Tinnerman Products Inc., Cleveland, Ohio, engineered a one-piece Speed Clip to replace it—by forming one thread in the blade and two prongs to lock the screw (see inset above). This simplification called for a superior phosphor bronze. Tinnerman found it in Duraflex, Anaconda superfine-grain phosphor bronze. It has higher tensile strength and endurance limit for long-lasting dependability—greater formability for economical manufacture. The result: unit costs were cut— and G-E assembles controls faster, more easily. 0041

Quality control and cost reduction can go hand in hand. The secret is often simply matching the metal to the job. And Anaconda specialists, starting with 93 standard alloys, can offer an almost unlimited number of combinations of useful properties. For creative help in meeting your problems, write The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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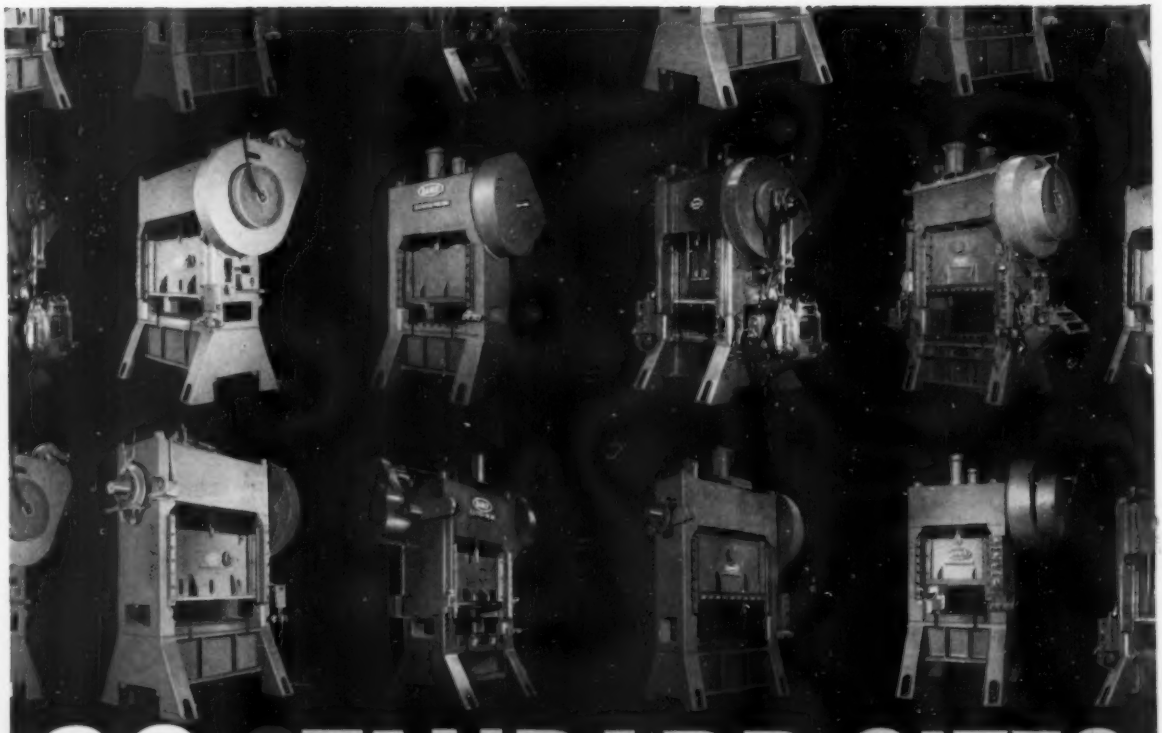
NICKEL SILVER MILL PRODUCTS

Made by The American Brass Company



90 STANDARD SIZES

in a Custom-Quality Press

See the Danly Display at the Machine Tool Exposition, Booth No. 1250

Take your choice of dependable Danly SC crankshaft presses in capacities from 50 to 300 tons...bed areas to 72″ x 60″...with strokes to 16″...constant or variable speeds to 90 SPM... with non-geared, single or double-geared drives...equipped for manual or automatic feed.

Every SC press gives you Danly's patented low-maintenance air-friction clutch, husky welded-steel frame, and countless other custom-quality features.

For low-cost piece part production ...in blanking, drawing, piercing, forming, or progressive die stamping... you'll find your choice of Danly SC Presses ahead of the field and best for you. WRITE FOR NEW SC CATALOG and get all the details.

DANLY

DANLY

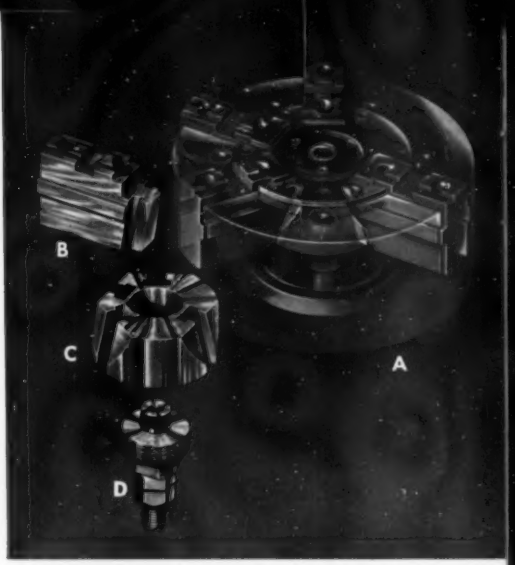
DANLY MACHINE SPECIALTIES, INC., 2100 S. LARAMIE AVE., CHICAGO 50, ILLINOIS

one chuck
with
two or three jaws

SKINNER DUAL PURPOSE POWER CHUCK

One Dual Purpose Power Chuck saves the cost of an additional chuck

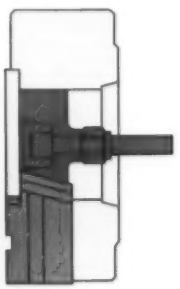
Skinner dual purpose standard power chuck is designed with four master jaws so that it may be used as a two or three jaw chuck. It is no longer necessary to pay for one chuck to machine round work, and an additional chuck to machine odd shapes and castings. Not only do you save the cost of an additional chuck but you get all of the advantages of Skinner power chuck design listed below. Skinner dual purpose power chucks are available with adjustable, non-adjustable, or serrated jaws, in sizes 8″ to 36″.



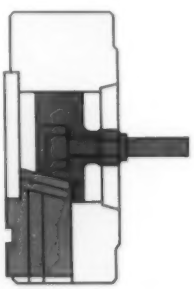
A—Transparent view of dual purpose power chuck B—Master Jaw
C—Wedge D—Drawbar Stud and Wedge plug

Skinner wedge-type chuck offers these advantages

- Allows automation of long production runs.
- Reduces operator fatigue—air performs the muscle work.
- Adjustable gripping pressure—air pressure can be adjusted for light or heavy chucking—is not left to the judgment of the machine operator.
- Work can be gripped internally or externally.
- Assured continued high accuracy because of wedge design (see illustration).
- Reduced wear because of hardened parts—models available with flame hardened center hole and jaw locks.
- Complete line—heavy and light duty models in sizes from 4″ through 36″.



Wedge at top of stroke—
jaws fully open
(External gripping)



Wedge at bottom of stroke—
jaws fully closed
(External gripping)

The wedge and three jaws—only four moving parts—operate as a collet does with accuracy maintained over the whole range. The wedge angle is 14° which was found to be the most efficient angle for maximum power and jaw travel. With this wedge construction, the grip of a Skinner power chuck holds as set—even if the air line is broken—until opening power is applied in the opposite direction.

Skinner Power Chuck Accessories

Double-Acting Rotating Air Cylinders for use with power chucks and fixtures provide maximum pressure with a minimum amount of air. Cylinder walls are burnished to provide maximum sealing life. Cylinders in sizes 6 to 18 with semi-steel bodies are designed for low speed operation. Aluminum body cylinders in sizes 4 to 20 are designed for high speed operation.

Packaged Power Chucking Assemblies are available for Atlas, Cintilathe, Hardinge, Logan, Regal, Sheldon, South Bend, and many similar lathes. Assemblies are also available for Brown & Sharpe and similar automatic and hand screw machines to permit chucking of cold drawn parts, small or odd shapes and castings. Packaged assemblies consist of chuck with two or three jaws, threaded drawbar or drawtube, rotating air cylinder, cylinder adapter and necessary mounting for the individual machine.

Power Chuck Fixture, air or hydraulically operated, holds work for drilling and milling machines and for other bench and machine installations. Available in many jaw types in sizes 5″ to 36″.

A Complete Line of power chucking accessories includes hand, foot, and solenoid valves, drawbars, air units, and soft blank top jaws.

• • • •

For complete information about the Dual Purpose and other power chucks and power chuck equipment, contact your Skinner Representative, Distributor, or write us at the address below.

SKINNER CHUCKS®

THE CREST OF QUALITY

SKINNERCHUCKS

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

A COMPLETE GEAR PROGRAM

TO ASSURE YOUR PRODUCT'S EFFICIENCY

MMT-PE
MODERN MACHINE TOOLS
PRODUCTION EFFICIENCY

Visit us at the Machine Tool Exposition, Booth No. 242

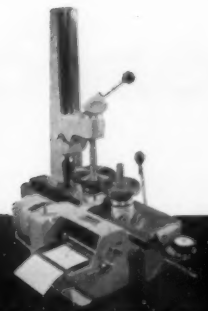
Whenever you have a gear problem—any gear problem—consult Illinois Tool Works for the right answer!

From transmissions to turbines—from radar antennas to atomic reactors—if your product requires gears or gear trains, Illinois Tool Works has the experience, skill and facilities to solve your gearing problems.

Gear users and gear producers are now offered valuable assistance in gear analysis, gear design, prototype and model manufacture, gear tooling and quality control. This complete program is available to help you improve product efficiency and economy to strengthen your competitive edge.

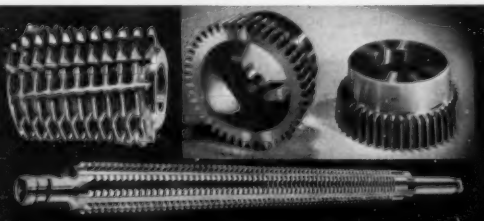
As a proven advisor to the Army, Navy and scores of power-product manufacturers, Illinois Tool has gained the background and engineering know-how to accurately analyze your gearing problem and to recommend the most satisfactory solution for your specific requirements. This service even includes training your personnel.

Write Today for your "Gear Technical File"



GEAR QUALITY CONTROL

Gear specialists at Illinois Tool have developed gear measuring instruments, ranging from simple hand rolling fixtures to fully automated final gear inspection machines. Among these are units capable of mechanically inspecting hundreds of gears per hour for all known elements and sorting them categorically. Whatever your quality control requirements let Illinois Tool recommend the system best suited to your needs.



GEAR TOOLING

Illinois Tool Works hobs, shaper cutters, broaches and gear cutters are used to produce thousands of gears daily. They are specified by nearly every major gear producer in the country—proof of their quality, efficiency and economy.

INSPECTION

ANALYSIS AND DESIGN

PROTOTYPES

EMPLOYEE TRAINING

GEAR SERVICES

Illinois Tool Works maintains (a) a complete atmosphere-controlled laboratory fully equipped for analyzing and inspecting gears, gear trains or gear-like parts; (b) an engineering staff to design and or recommend gear drives; (c) development facilities to produce models and prototypes; (d) a process group to detail production and quality control procedures; (e) employee training for your personnel which includes a highly concentrated classroom-and-shop course in gear engineering, production and quality control.

ILLINOIS TOOL WORKS
TOOL & INSTRUMENT DIVISION
2501 North Keeler Avenue • Chicago 39, Illinois
In Canada: CITCO DIVISION, CANADA ILLINOIS TOOLS, Ltd., Don Mills, Ontario

New Economics of

Big money being wasted because of traditional concepts in lathe utilization can now be saved.

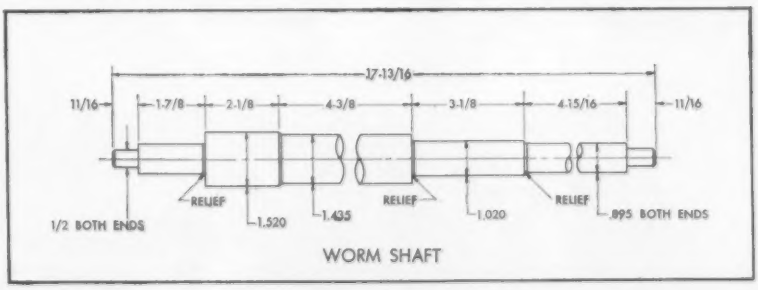
The two jobs illustrated, taken from the same lathe department, prove that Barber-Colman's new 1610 "specialist" lathe—for turning, facing, and boring—is an economically sound machine concept for almost any shop.

Elimination of threading equipment—features which are not fully utilized on many lathes—produces an initial cost saving that can pay for a hydraulic tracer. The manufacturer of these parts (below) had plenty of threading capacity on older machines, so he elected to take a valuable hydraulic tracer for the cost of threading equipment he really didn't need.

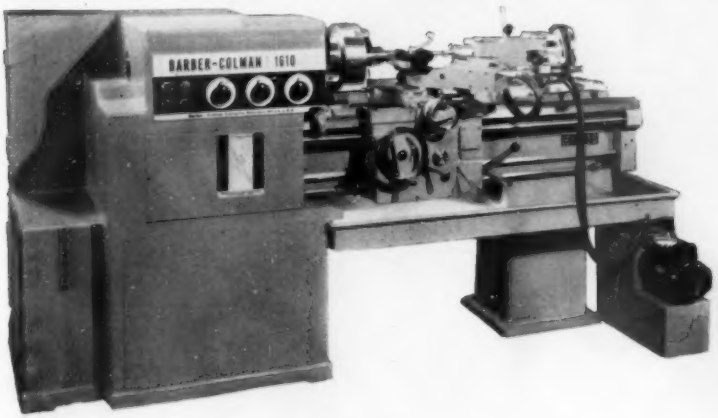
Of course, there are many operating benefits to be gained. Spindle speed and power feed to both carriage and cross slide are infinitely variable. Ability to change both speeds and feeds without stopping the machine increases production on a great many jobs. Over-all result: A new kind of lathe specialization that minimizes capital investment for certain classes of work and opens a valuable opportunity to improve *total* machine utilization. Here are some of the specific results this manufacturer achieved.

The worm shaft was shifted from a turret lathe to the tracer-equipped Barber-Colman 1610 for facing, center drilling, and turning. Threads are now cut on a threading machine. This shift reduced total cutting time 32% and setup time 12% (including time on a threading machine). But time on a machine has to be reckoned in dollars, not minutes. Capital investment in the turret lathe is much more than for the 1610 lathe. What's more, the operator of the turret lathe is a Class

The new 1610 lathe with tracer will be on display in the Barber-Colman Booth (No. 923) at the 1960 Machine Tool Exposition. It will confidently stand your most critical inspection.



Report shows how one Barber-Colman turning lathe initiated important methods improvements throughout a department.



"Specialist" Lathes

A, while the operator of the 1610 is Class B. And to further prove how ultimately practical this new lathe is, the Class B operator not only turns out more work, he also scraps fewer parts.

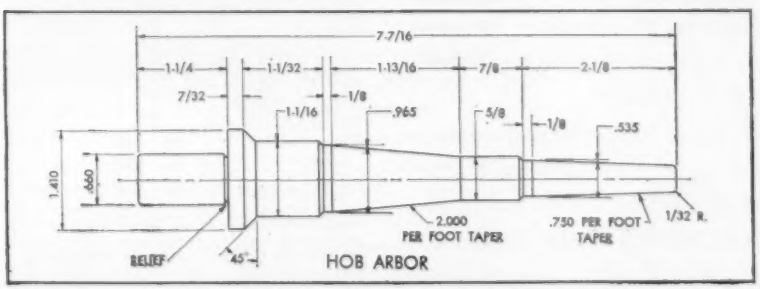
Utilization: tracer vs threading

Perhaps you are in the same position as this manufacturer: You have enough lathes to handle your threading requirements, but not sufficient tracing capacity. If so, a 1610 with tracer will be a particularly profitable investment for you. Take this hob arbor as an example.

By shifting the job from a conventional lathe without tracer to a tracer-equipped 1610, production was increased over 100%—from 1.5 to 3.3 pieces per hour. Setup time was reduced 40%. The important point is, this manufacturer is now using both his old lathes and his new machine more profitably. Here's why.

Maximum cutting speed on the old lathe was 632 rpm and feed was .0092" per revolution. On the 1610 FT, speed *ranges* from 900 to 1500 rpm and feed is .015" per revolution. A load meter allows the operator to obtain maximum production. In other words, there's quite a difference in capacity between an old lathe and a modern lathe. And since threading normally requires *slow speeds*, doesn't it make sense to thread on your older machines—and do turning, facing, and boring operations on this high-speed "specialist"? Why put low-speed work on a high-speed lathe?

The 1610, with 16" or 20" swing and 6½ hp motor, is a precision lathe capable of turning out toolroom quality work. If you are in the market for a new lathe, phone your Barber-Colman representative or write us for descriptive literature and complete specifications. Ask for Bulletin No. 9061-1.

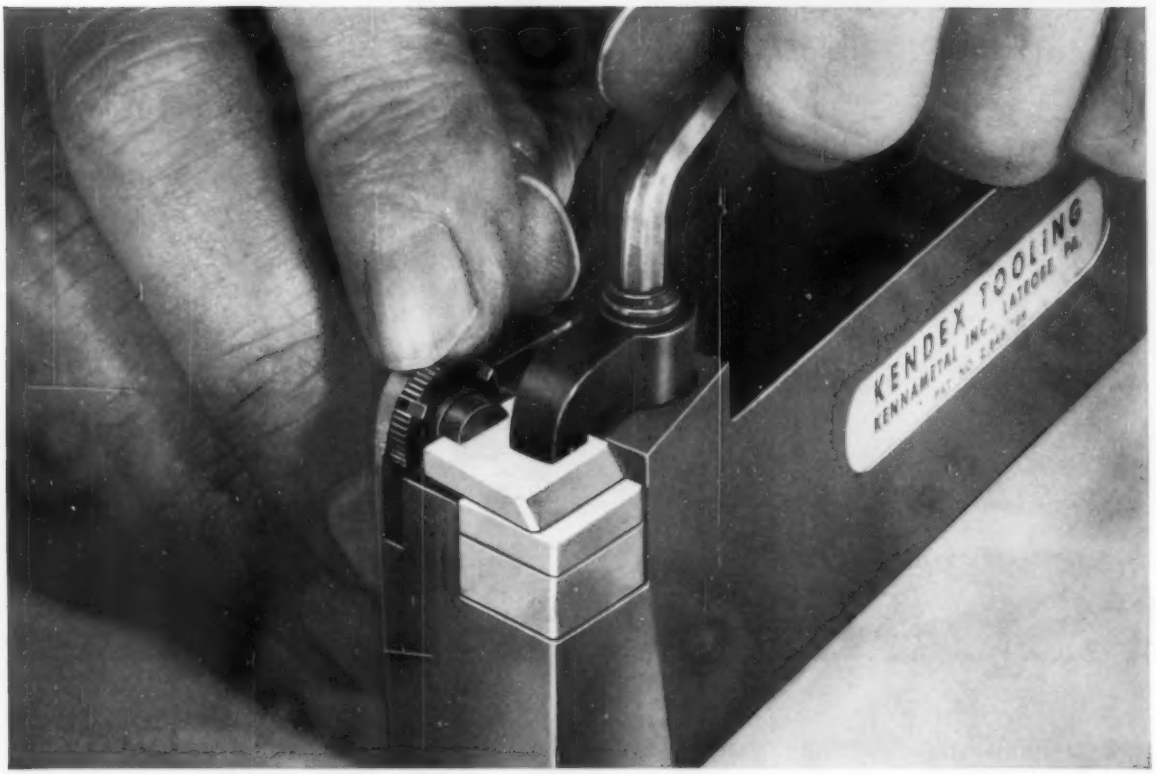


Barber-Colman Company

BARBER COLMAN

83 Loomis Street, Rockford, Illinois

SEE NEW KENNAMETAL*



Easy adjustment, regardless of tool position. Just release the clamp and "dial" the breaker to any position desired.

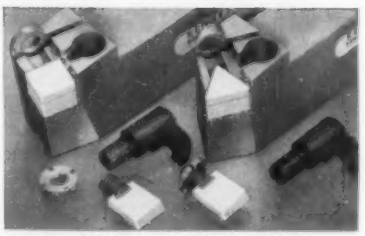
NEW KENDEX* DIAL-A-BREAKER

Easily adjustable... attached chipbreaker

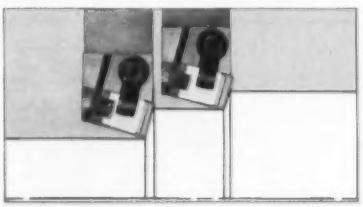
Quickly, easily . . . set the chipbreaker where you want it, regardless of holder position. The new Kendex Dial-A-Breaker eliminates fumbling and fussing while changing and adjusting chipbreakers and inserts. Chipbreaker is brazed to its adjustment screw. It can't fall out, and the breaker setting is retained while indexing or changing inserts.

You no longer need a different breaker for every cutting job. Just turn the dial and position one chipbreaker for several jobs. Minimum of parts to stock . . . only two chipbreakers required for 70 styles and sizes of holders.

Kendex Dial-A-Breaker Tool Holders have the same basic design and accommodate the same solid Kennametal shims and "throw-away" inserts as used in standard Kendex holders. They are available in positive or negative rake, and with square or triangular inserts.

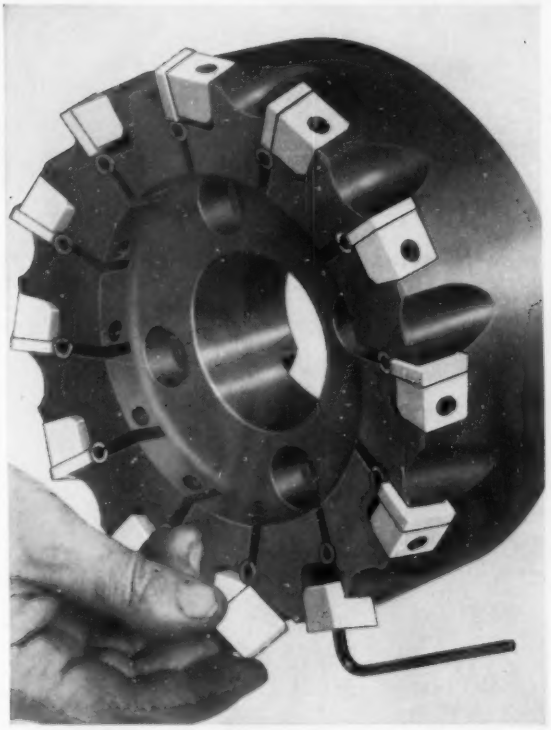


Holders with clamps and chipbreakers removed to show positive seating of both triangular and square inserts. Tool can be used without chipbreaker if desired.

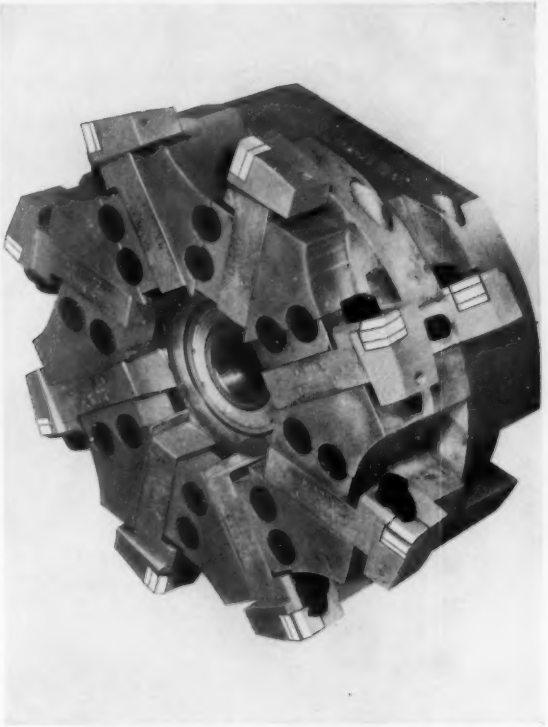


All adjustments, chipbreaker and insert, can be made from the top of the holder. Permits close ganging of tools. (Clamp screw is also accessible from the bottom of tool when mounted in an inverted position on the rear carriage.)

TOOLING AT CHICAGO SHOWS



Retracting the wedge, by means of a double-end screw, quickly releases the inserts. Held in by the screw, the wedge cannot fall out, regardless of the cutter body position.



Multiple insert Kendex head enables a major automobile manufacturer to bore and chamfer brake drums in one pass. Cutting edges can be indexed in a few minutes.

NEW KENDEX MILLING CUTTER

uses "throw-away" inserts

No grinding, no blade resetting! Each ¾-inch square Kennametal insert provides eight separate cutting edges. When one edge becomes dull, the clamp is released and the insert given a quarter turn to a new, sharp edge. It is then reclamped, without need to reset or gage the tool. When all eight edges (four on each side) have been used, the insert is replaced by a new one.

With a heavy cutter body . . . and more than ⅝-inch of solid Kennametal backing up each insert . . . new Kendex Milling Cutters are built for the rugged service necessary for fast metal removal. The one-piece cutter body is made of heat treated steel. A 15-degree corner angle minimizes pressure on the workpiece. Solid Kennametal wedges and seats provide close-tolerance, positive positioning of the insert . . . to permit maximum utilization of available power.

*Trademark 33527

SPECIAL KENDEX "DESIGN-AND-BUILD" SERVICE

combines 2 or more operations in 1 pass

When "standard" tooling won't do the job . . . we will design and build tooling that *will* . . . such as special Boring Bars, Boring Heads, Multiple Tool Block Tooling, Hollow-Mill Tooling. Some examples of these Kennametal "specials" will be on display at the Chicago Shows.

SEE US IN CHICAGO

MACHINE TOOL BUILDERS SHOW
International Amphitheater—North Hall
Second Floor—Booth 1500—Adjacent to Restaurant

PRODUCTION ENGINEERING SHOW
Navy Pier • Booth 111

SEPTEMBER 6-16

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...Partners in Progress

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WIEDEMATIC
TURRET PUNCH PRESS
with Numerical Positioning Control

60 HOLES A MINUTE
with Automatic Work Positioning and Tool Selection

SEE the Wiedematic position and punch holes of many sizes and shapes automatically in actual production runs of sheet metal and plate parts.

SEE how all press operations are controlled with amazing speed and accuracy by an easily prepared punched tape.

SEE how the Wiedematic Method reduces production costs 60% to 90% and provides the key to major savings in every other phase of your operations from design to final assembly.

Be sure to see the Wiedematic in operation — Booth 1249 at the Machine Tool Exposition.

WIEDEMANN

WIEDEMANN MACHINE COMPANY
DEPT. IA-10 • GULPH ROAD • KING OF PRUSSIA, PA.

International Amphitheatre
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REGISTER HERE,

IN FLEXIBLE FABRICATION

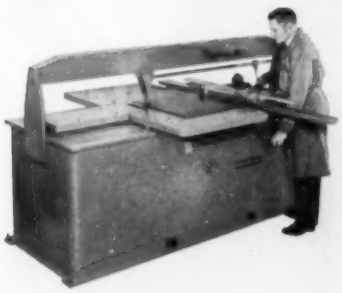
WIEDEMANN TEMPLAMATION

Making Full Use of Low Cost Templates For Fast, Accurate Piercing

SEE how Wiedemann Templamation employs templates to ensure accuracy and reduce piercing costs.

SEE how high accuracy templates are made rapidly on the COORDINATOR . . . inspected without guesswork on the direct reading INSPECTOR . . . then used for positive work positioning on a WIEDEMANN Turret Punch Press equipped with a high speed follower gauge.

SEE how Wiedemann Templamation gives you many of the advantages of automation with manually operated machines.



1. TEMPLATE IS MADE ON THE WIEDEMANN COORDINATOR

2. TEMPLATE IS INSPECTED ON THE WIEDEMANN INSPECTOR

3. TEMPLATE IS USED FOR HIGH SPEED HOLE POSITIONING ON THE WIEDEMANN RA-41P TURRET PUNCH PRESS

Other Wiedemann Turret Punch Presses will also be in operation.

THEN HEAD FOR THE FAR CORNER—BOOTH 1249

WIEDEMANN

New P-K® Socket Screws with **Long-Lok® Inserts**

Notice the groove in the thread. It's permanently filled with Polycap, a nylon type polymer that provides self-locking action over a wide temperature range.

Simple? True! It's an efficient, practical solution to 1001 problems . . . wherever vibration is present—where adjustment is required—where re-use is a factor.

In industrial and consumer products . . . in electronics, engines, hydraulics, valves, supersonic guided missiles—P-K Socket Screws with Long-Lok Inserts give you many advantages . . .

- Higher resistance to shock and vibration
- Superior thread engagement and locking force
- Higher percentage of reusability
- Eliminates the need for lock washers, safety wires

A COMPLETE LINE—You can get P-K socket head cap screws (1936 and new 1960 "Prelode" Series); set screws, including the revolutionary P-K W-Point*†; button heads, flat heads, shoulder screws and pipe plugs; all *with* or *without* the Long-Lok insert. And don't forget P-K quality-controlled dowel pins, hex keys and key kits!

Ask your P-K distributor for samples and technical data, or write directly to Parker-Kalon for bulletin No. 862.

*T.M. †U.S. Patent No. 2,907,245

PARKER-KALON® *Socket Screws*

PARKER-KALON, a division of General American Transportation Corporation, Clifton, N. J. Offices and warehouses in Chicago and Los Angeles.

DEPENDABLE... predictable response to heat treatment every time

Send for Bulletin 102— "Helpful Heat-Treating Hints."

The full uniformity within each bar of Desegatized FM die steel and the consistent uniformity from lot to lot simplifies the heat treatment of your die components. Predictable hardnesses are readily attainable . . . distortion and size change are minimized . . . danger of cracking is lessened!

In free machining FM die steels, full uniformity is achieved through Latrobe's unique Desegatized process of manufacture. This process guarantees an even distribution of carbide particles, free machining alloy sulphides and other alloying elements . . . factors leading to improved machinability, greater toughness and improved wear resistance in addition to the optimum heat-treating characteristics.

Latrobe's 12% chromium FM die steels are available through district steel service centers near you. Grades include: Olympic FM (Type D-2) for long-run applications; GSN FM (Type D-3) non-deforming die steel; Cobalt Chrome FM (Type D-5) for extra resistance to galling and pickup.

Call your Latrobe representative today!

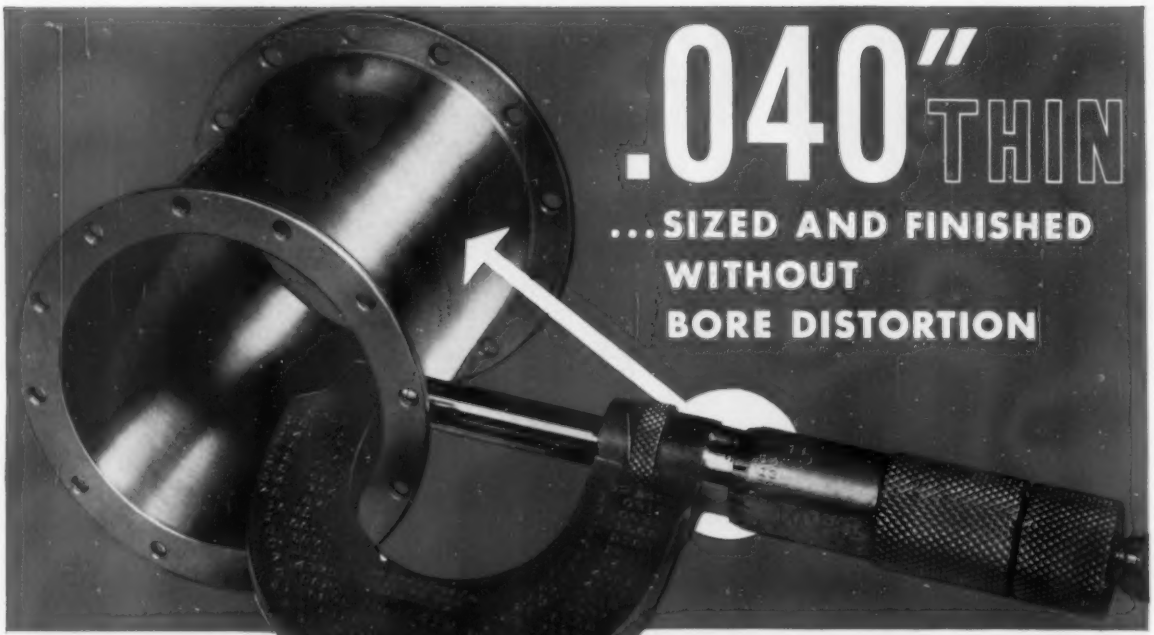
Manufactured by skilled American labor

LATROBE Metalmasters

LATROBE STEEL COMPANY

LATROBE, PENNSYLVANIA

BRANCH OFFICES and STEEL SERVICE CENTERS: BOSTON • BUFFALO • CHICAGO CLEVELAND • DAYTON • DETROIT • HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE NEW YORK • PHILADELPHIA • PITTSBURGH • SAN LEANDRO • TOLEDO

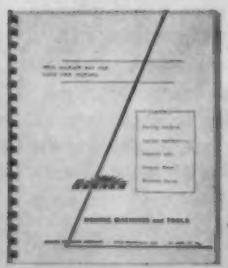


RANGE OF SUNNEN HONING TOOLS

- For Machine Applications
Standard from stock,
.100" through 2.625" dia.
Built to order, through 4½" dia.
- For Portable Applications
from 1¾" through 20½" dia.

AVERAGE COST WITH TOOLING
ONLY $1000

MODEL MBB-1296D ILLUSTRATED



FREE BULLETIN #SP-11
Gives production rates on 99 typical honing applications. Contains valuable information on Sunnen Honing Machines — Mandrel Sets — Portable Hones — External Hones — New Precision Hole Gage

SUNNEN® PRODUCTS COMPANY
HONING

7927 Manchester Ave. • St. Louis 17, Mo. • Canadian Factory: Chatham, Ontario

In many cases, it's impossible to produce true-round bores in thin-walled parts by any process that requires chucking. Reason: They "spring back" when chucking pressure is relieved. Cutting tool pressure and heat generated during stock removal will also distort many thin-walled parts.

SUNNEN HONING solves all these problems! With this efficient stock removal process . . . no chucking is required because the work piece "floats" on the honing tool. *Chucking distortion is eliminated!* Stock removal is fast . . . with relatively low pressure and surface speed. *Distortion from cutting pressure and heat is eliminated!* Results: A geometrically true-round, straight bore.

Production tolerances held on the 1¾" bore stainless steel cylinder shown above are ±.0002". . . with 8 micro-inch finish and .003" average stock removal.

Your own machining problems may not be quite this difficult, but Sunnen Honing will save you money if you do internal work of any type. It guarantees accuracy to .0001" with any desired finish down to 2 micro-inches

8922

SATISFIED CUSTOMERS ARE THE FOUNDATION OF OUR BUSINESS

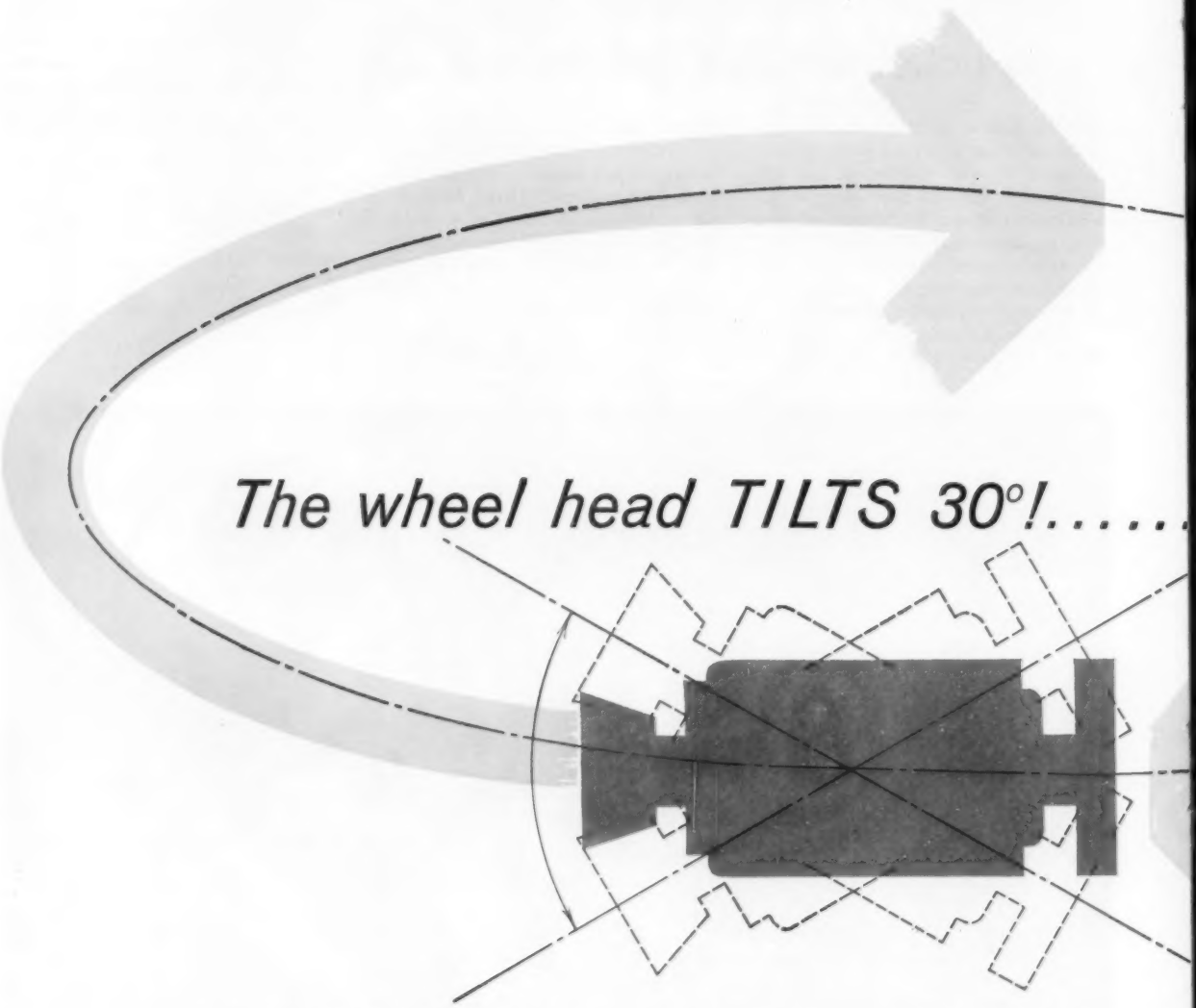
How steel tubing saves weight in helicopter...in budget, too

Shown below is the main rotor shaft of a new model helicopter. Because it was hollowed out of solid steel bars to save weight, it was costly to make. After machining to thousandths of an inch accuracy, previously undetected steel flaws showed up. One out of every five parts had to be rejected.

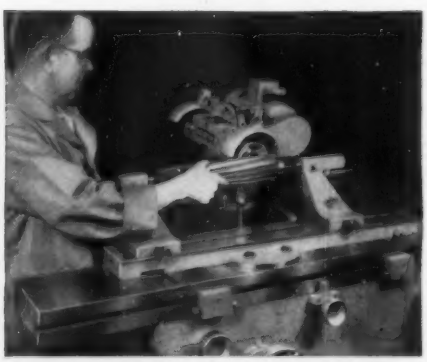
Timken Company Metallurgists were consulted. After careful study, they recommended a special analysis of Timken® seamless steel tubing. Savings began immediately. Because the hole was already there, no drilling was required. Steel was saved. And with the extra advantage of uniform forged quality in Timken seamless tubing, rejects of finished parts were practically nil.

Let us help you cut your costs, get better quality finished products. Our engineers will recommend the most economical tube size for your hollow parts jobs, one guaranteed to clean up to your finish dimensions. **When you buy Timken Steel you get:** *1) Quality that's uniform from heat to heat, bar to bar, order to order. 2) Personal attention from the experts in specialty steels. 3) Over 40 years experience in solving tough steel problems.* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES



The NEW NORTON No. 200 Cutter and Tool Grinder makes setups simpler . . . easier . . . quicker!



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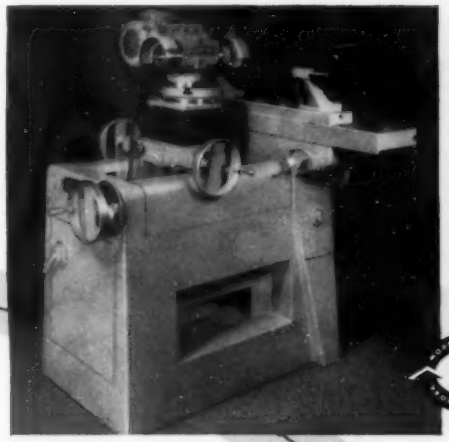

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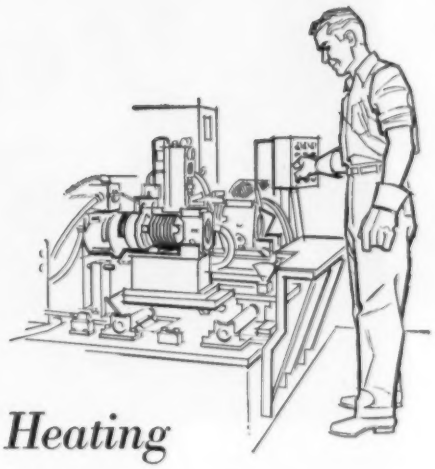

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Your Society invested a modest sum in a cooperative project with the American Society for Engineering Education. The project, a two-day seminar on the subject of metal processing courses, was held at Purdue University in connection with the annual meeting of the ASEE and is reported on page 90 in this issue.

The seminar, which was attended by 61 top-flight engineering educators from the nation's leading engineering schools, was a resounding success, if success can be judged by the enthusiastic comments of those who participated.

The sound investment, as far as ASTME is concerned, is the big stride forward taken with these key educators in showing them the importance of training engineering students for responsible manufacturing engineering positions in industry.

One of our ASTME objectives for the year is to get educational institutions to appreciate the importance of tool and manufacturing engineering in industry, to establish courses that will result in graduates qualified for the highly competitive metalworking field, and to effectively utilize the technology available from the tremendous sums being invested in research and development.

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Dale Long

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ELIMINATING SECONDARY OPERATIONS

...short-cut to greater efficiency

By Leslie Hoffman*
Tool Engineer
Methods Analysis Engineering
International Business Machines Corp.
Lexington, Ky.

Performing all operations on a stamping —including hole sizing and countersinking—on one progressive die eliminates extra handling and improves quality. Keeping control of a part until all operations are completed is a fruitful approach for all types of operations—high-production or low-production.

SECONDARY OPERATIONS are of primary importance in the manufacture of precision stampings. The accuracy of holes is dependent on hole sizing and countersinking operations and these operations can add substantially to the cost of the part.

Depending on part design, the size of production runs and related requirements, any one of several hole sizing and countersinking methods may be a good—or bad—choice. Each method has its advantages and disadvantages. Drill press reaming, for example, is one of the simplest methods for achieving precise hole size. Unless automation is used, however, it is a slow, fatiguing hand operation and labor costs are high. The fine, circular marks left by the reamer may make a subsequent honing operation necessary, depending on the surface finish required. Spindle or chuck runout and, occasionally, an untrue shank, can cause out-of-round holes. Rapid beakdown of cutting edges necessitates frequent tool changes to maintain size.

Another alternative is shaving to final dimensions in secondary or progressive dies. This method is more economical than reaming but, like reaming, it has several disadvantages. Miss-hits caused by the punch and die closing out of station chip tools. The punch and die must have extremely sharp cutting edges, requiring frequent attention. Sometimes slugs are pulled to the die surface or jam in the die cavity, which can cause maintenance problems. The punch press must be carefully maintained; unless alignment is good, shaving is impracticable.

Ball burnishing with carbide balls is still another way of hole sizing. An advantage of this finishing method is that sizing can be accomplished after the stamping is hardened to as high as 45 R_C. There is some danger that the burnished hole may close up after the ball is forced through. Carbide balls develop flat spots, which complicates the dimensional control of burnished holes. Tooling and mainten-

*Senior member ASTME Cleveland chapter.

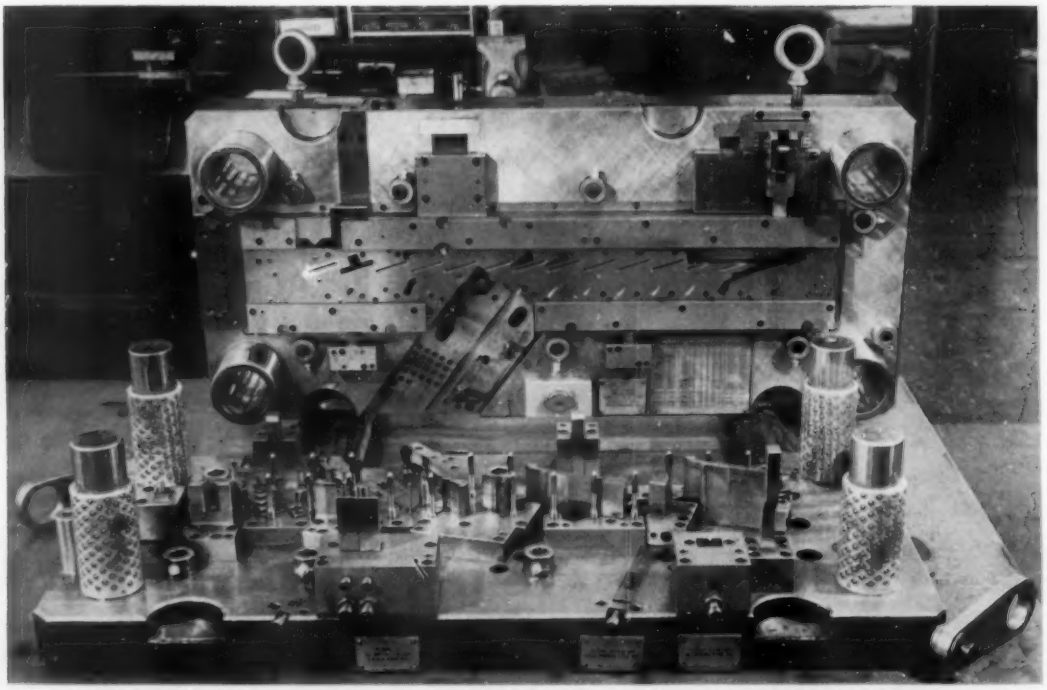


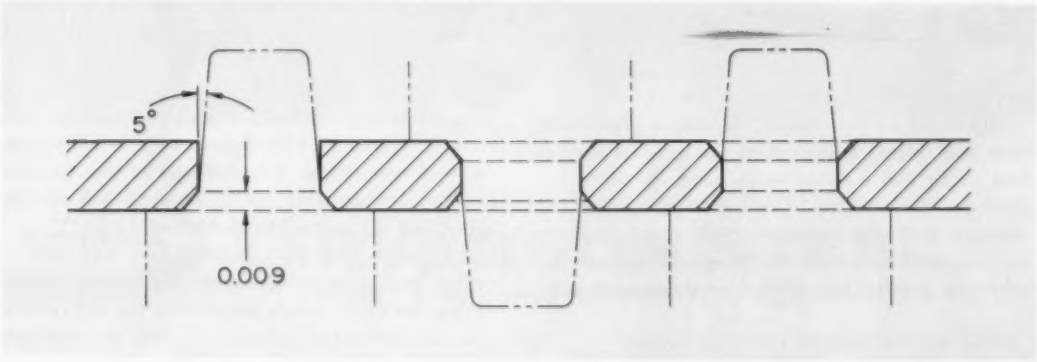
Fig. 1. Progressive die for performing piercing and combined countersinking and hole-sizing operations.

ance costs, particularly the replacement of carbide balls and broken ram punches, are high.

To remove burrs caused by reaming, shaving or ball-sizing, countersinking operations on both sides of the stamped part are necessary. Pierced or drilled holes, too, usually require countersinking. Vertical drill press methods of countersinking are slow and the operator has to turn the workpiece over to complete both sides. The effectiveness of the countersinking operation is dependent on the operator since the tool is guided by hand pressure. Dull countersinks may push burrs back into the hole, so good tool maintenance is a necessity. Since constant contact is made at only one cutting point of the countersink, rapid wear ensues at this point. With a worn countersink, the operator tends to apply greater pressure and a cold spinning action results. In such cases, an internal burr or ledge is created. Drill press countersinking operations can be made faster by the use of opposed spindles to countersink both ends of a hole simultaneously, but hand stacking or hand feed is still mandatory and part quality varies.

It is apparent that the usual methods for sizing and countersinking holes all have major disadvantages. At IBM, these disadvantages are avoided by

Fig. 2. Tapered punch (left) performs initial hole-sizing and countersinking operation. The other end of the hole is sized and finished in the middle station. If metal is moved into the bottom countersink by the second operation, a resize station (right) is used to obtain final dimensions.



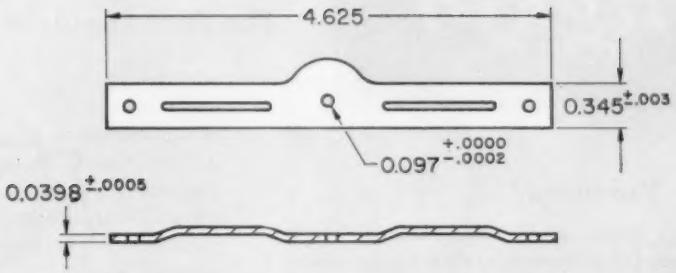


Fig. 3. Hole in typewriter reciprocating lever is countersunk and sized in a die operation.

performing piercing, hole sizing and countersinking operations in the same progressive die, *Fig.* 1.

In the IBM dies, the holes are sized and countersunk by a cold swaging process. The principle is simple: the countersink reduces hole diameter and closes against a pilot protrusion. The hole is sized and burnished as the punch retracts, *Fig.* 2.

This hole finishing method was developed for small business machine parts. Hole size tolerances are from ± 0.0001 to ± 0.0003 inch. Countersink depth tolerances are from ± 0.001 to ± 0.003 inch. The same hole-finishing principle can, of course, be applied to holes with broader tolerance ranges.

This process has been successfully applied for finishing a pierced wire fulcrum hole in an electric typewriter reciprocating lever, *Fig.* 3. This is a high-volume part: production is several million parts yearly. Finished hole size is 0.097 inch + 0.0000, — 0.0002 inch.

The lever is pierced, notched, embossed, blanked and formed out of C-1050 cold-rolled coil stock, No. 2 bright finish, 0.0395 inch thick, ± 0.005. Hardness of the stock is 80-90 R_B.

Previously, the stamped parts were austempered to 42-44 R_C and then tumbled. Following tumbling, the pierced fulcrum wire hole was ball-sized and burnished, then countersunk.

To eliminate problems inherent in this sizing and countersinking method, it was decided to attempt to perform hole sizing and countersinking operations in existing progressive dies. An experimental single-station die was built for development purposes. This die gave good results so a progressive die was altered and several hundred parts made to test the process and to provide parts for functional testing. The diameter of the fulcrum wire holes produced by die sizing and countersinking was measured after 12 million strokes in a typewriter. The holes showed superior wear characteristics. There was no wear greater than 0.0002 inch in 75 percent of the parts tested, as compared to 0.001-0.003-inch wear on 90 percent of holes that were sized and countersunk by the old method.

In making dies of this type, ease of maintenance and setup must be kept in mind. Good access to the punches and dies is required for setting the effective heights while the die is in the press. With the die shown, the positive stripping and feeding action allows speeds as high as 180 strokes per minute. Runs of 250,000 parts have been obtained with no breakdowns and only 0.00005-inch wear on the carbide sizing punches. Finishes are 32 microinches or better. A 50-ton press is used.

The punch used in the first countersink station has a slight taper to prevent binding. Stripping pressure is high in the second countersink station, making a taper unnecessary. If a deep countersink is required, a third station to resize and reset the bottom countersink station is used, since the second operation tends to push metal back into the bottom countersink.

Incorporating hole sizing and countersinking operations in punch press dies has resulted in significant time and dollar savings. The quality improvement is also substantial. This points up the desirability of eliminating secondary operations, particularly in high-volume production.

"You just do the designing, I have to decide are they any good—I should have your sympathy."

Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

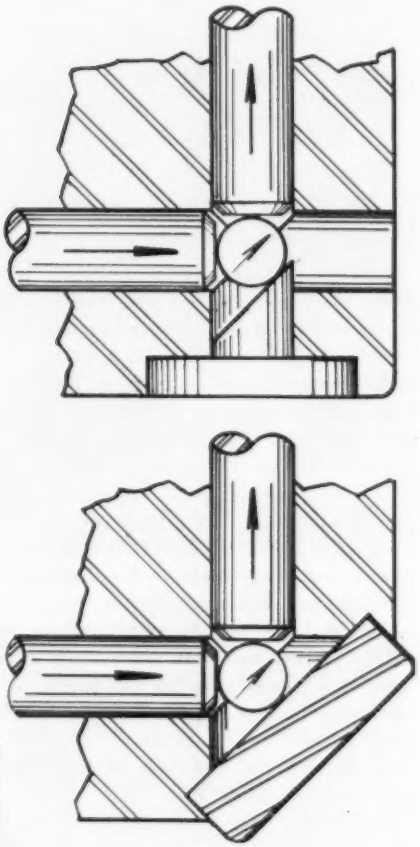
Gaging Movement*

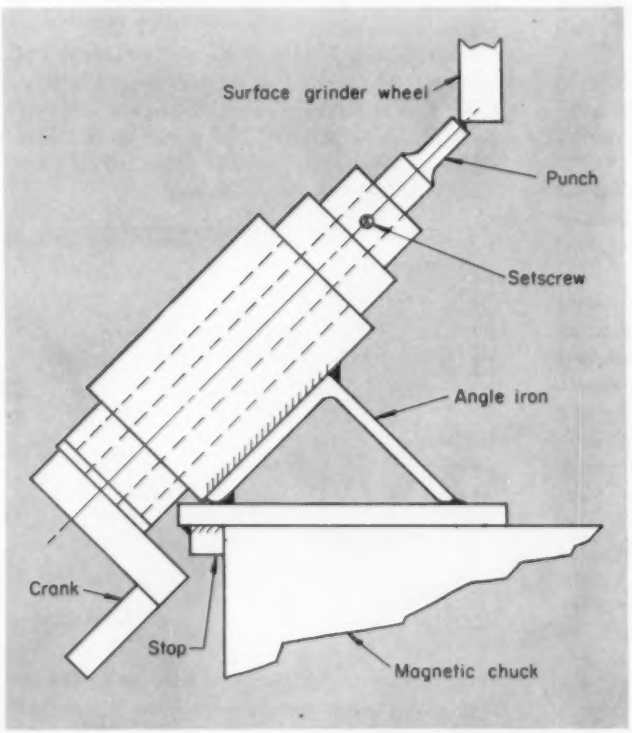
In certain gaging applications where dial indicators are used, it is necessary to impart component size variations to the indicator through a right-angle path of motion. This is usually done with sliding members mitered where they meet. Two disadvantages of this design are the cost of grinding the two mating 45-deg angles and the jerky motion that often results.

Illustrated are two alternate methods that will help overcome these conditions. Both sliding members are ground square at the ends and a ball is used as the contact medium. The ball rides on a single 45-deg angle on a separate unit that can be designed and fastened to suit the application. Besides savings in construction costs, the ball helps to smooth out the transfer of movement from the component to the indicator.

Allen M. Johnson
Springfield (Mass.) Chapter

*Gadgets Contest Entry





Punch Grinding Fixture*

Special punch points can be ground on a surface grinder by using the gadget illustrated. The punch is mounted in a hole in a crank assembly and held secure with a setscrew. The hole in the crank assembly is sized according to the shank size of the punch. In operation, the crank is turned to revolve the punch as the grinding wheel is fed in the appropriate direction.

H. Perina
Chicago Chapter

*Gadgets Contest Entry

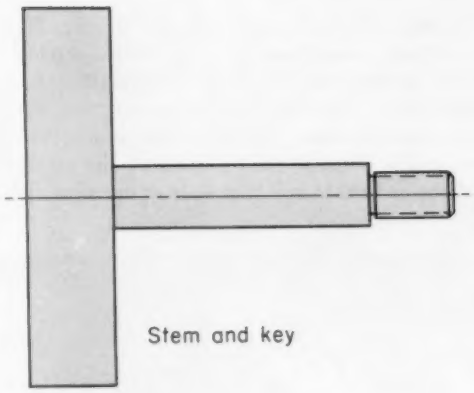
Lathe Fixture*

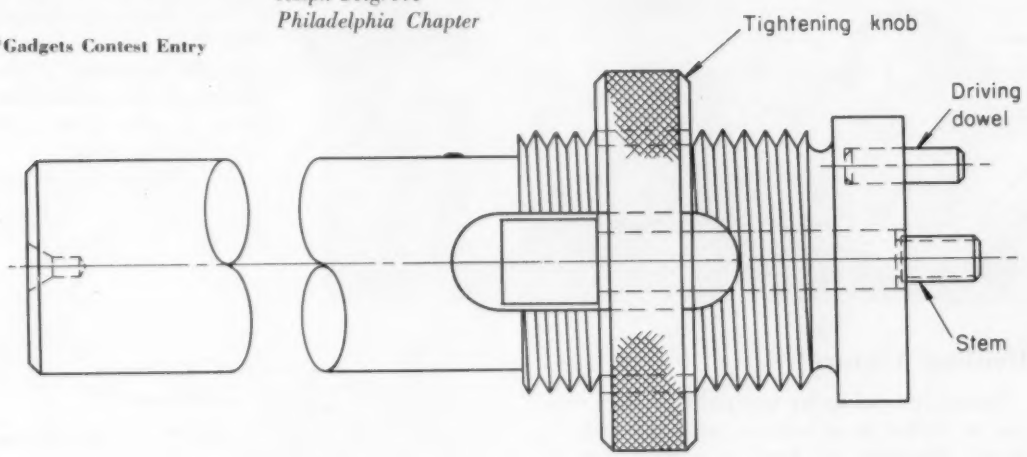
Rectangular blocks that have a tapped hole in the center of one end can be turned easily with the device shown. The large knurled nut is loosened and the center stem and key slid out to receive the tapped workpiece. The workpiece is screwed on and the step pushed in, placing the workpiece against a dowel pin driver in the face of the tool. The knurled nut is then screwed against the key to hold during the turning operation.

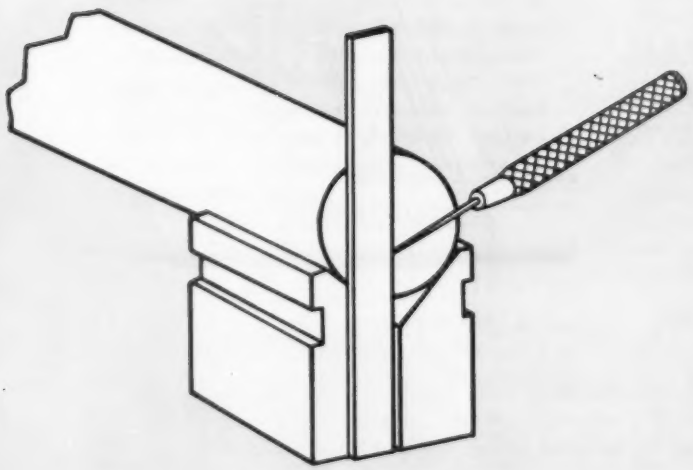
It is not necessary to remove or loosen any set-screws, nor are any extra wrenches or tools required to operate the fixture. For normal operations hand tightening is sufficient.

Ralph Colgrove
Philadelphia Chapter

*Gadgets Contest Entry







Scribing Method

Scribing centerlines on the ends of round stock is a common shop operation. The usual procedure is to set the shaft on a V-block and scribe a horizontal line with a surface gage. By grinding a shallow step in the end in line with the V in the block as shown, a vertical line can be scribed with a scale. The scale is placed against the edge of the step.

Ernest Jones
Bronx, N. Y.

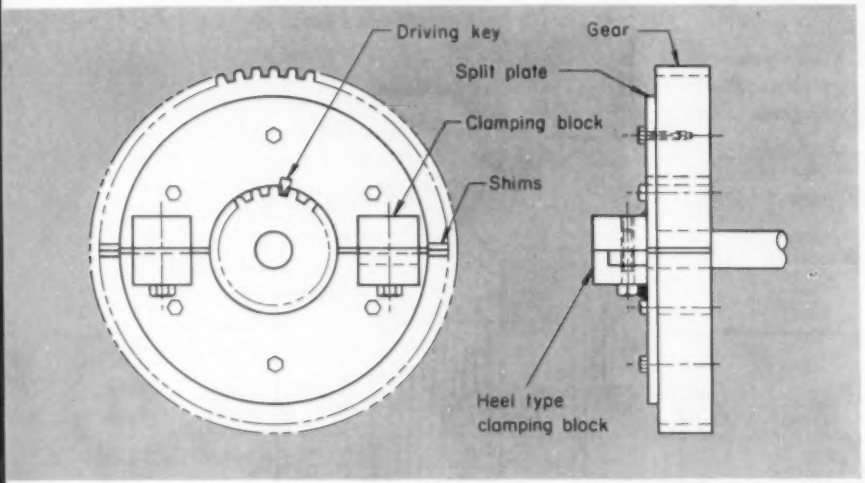
Gadgets

Quick-Change Gears

On setups which require changing of gears for various parts, many times an extensive disassembly problem is involved. To avoid this, a split gear mounted over a smaller one can provide two machine speeds without removal of the gears. The large gear is bored to the tip diameter size of the small one and cut in half. The ends of the segments are machined in about an inch from the teeth and shims are placed on these machined surfaces of a thickness to bring the gear to the true diameter. A split side plate is made with two clamping blocks welded to each half. A keyway is machined in the bore of the large gear and fitted with a key shaped to correspond to the small gear teeth.

One of the clamps is made with a heel so that a lever action exerts considerable force to hold the two gear halves together. This is necessary to prevent upsetting or tilt as working pressure is applied. If possible, the gear halves should be clamped from both sides or cast so that the centerline of the clamping bolt is midway between the sides of the teeth.

John Breen
Pittsburgh Chapter

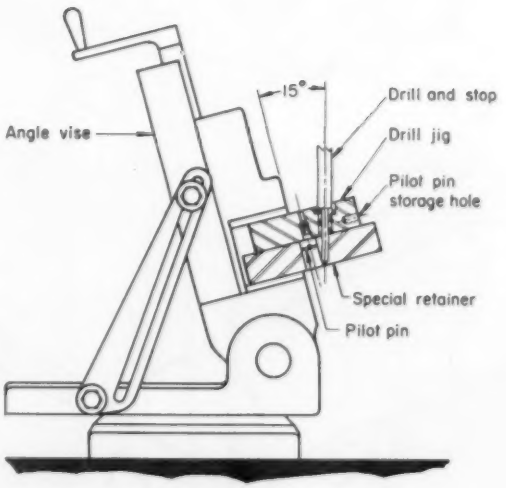


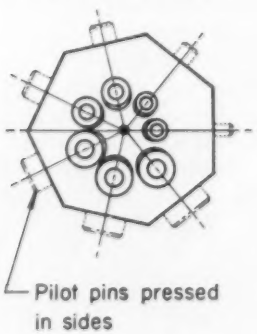
Drilling Fixture*

Special ball and spring type punch retainer holes can be drilled in a toolroom with the drill jig shown. Bushings are fitted in a multisided jig and are arranged in a circle around the center of the jig. The drill stop dimension for each bushing hole is stamped next to it. Each drilling hole has a corresponding pilot which is also stored in the jig in holes in the sides. The pilots are sized for each punch shank size to be processed.

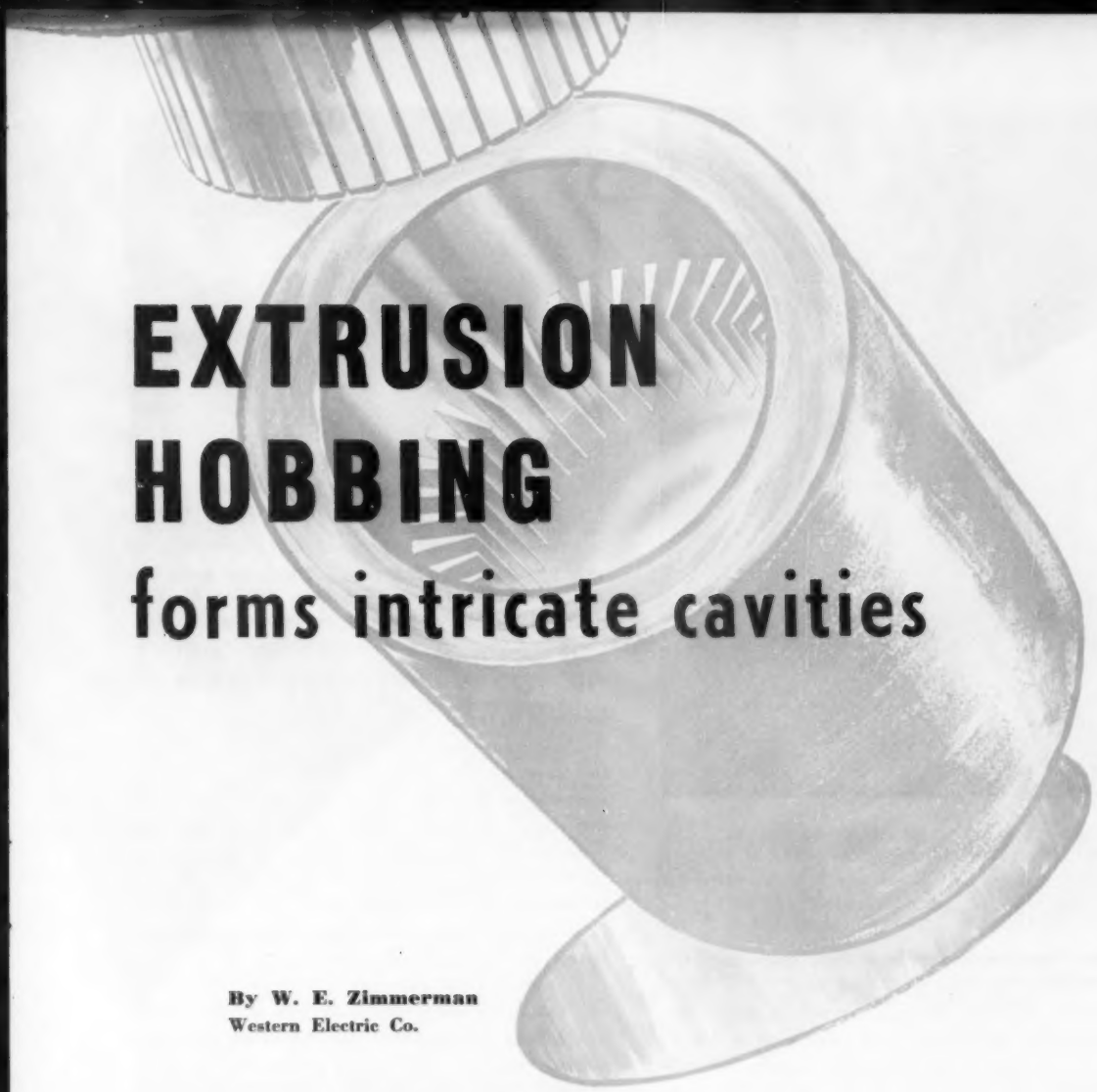
Francis E. Baskett
Evansville Chapter

*Gadgets Contest Entry





Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are necessary. Honorariums for accepted articles are sent upon publication.



EXTRUSION HOBBING forms intricate cavities

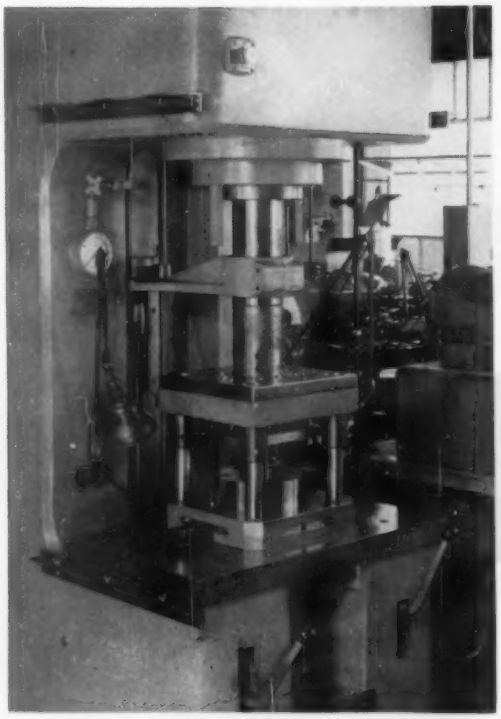
By W. E. Zimmerman
Western Electric Co.

Hobbing, a diemaking technique, can be successfully applied to the manufacture of small parts with complex internal configurations. By maintaining tight tolerances and providing superior surface finish, it proves an economical method of shaping "unmachinable" cavities on a production basis.

BECAUSE OF THE COMPLEXITY of design, anodes used in radar transmission tubes are impractical to manufacture by conventional machining techniques. However, one hobbing method used in producing intricate shapes in molding dies, has proved a successful method of manufacturing these anodes, as shown in *Fig.* 1. This technique has provided high production while maintaining close dimensional and surface-finish tolerances.

Basically the hobbing technique consists of forcing a tool called a hob into a piece of metal. Because of the severity of the hobbing operation and the delicacy of the workpiece, *Fig.* 2, preliminary studies were necessary and involved press selection, hob and die design, hobbing pressure and anode material most suitable for the process.

Press Selection: To meet the press requirements for hobbing the anodes, a Denison multipress of 75-ton capacity was selected, *Fig.* 1. This press is simple to control, has a slow ram movement and develops sufficient tonnage to hob the anodes. Part ejection at the completion of the press cycle is provided by an eight-ton hydraulic cylinder



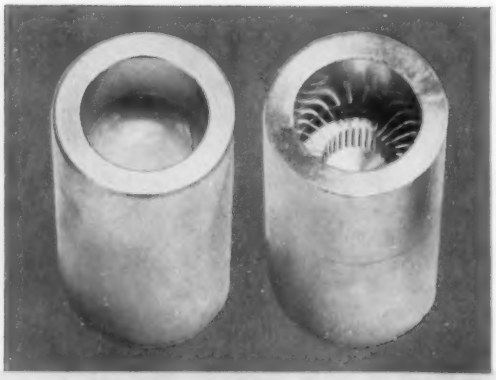


Fig. 1. (left) Hobbing die set up in press for extruding intricate part.

Fig. 2. (above) Anodes after preliminary (left) and final (right) hobbing operations. Mirror finish is obtained in cavity from second operation.

mounted beneath the bolster. In operation this unit is actuated by a foot pedal and is independent of the other machine controls.

Die Construction: Two dies, essentially the same except for their hobs, perform the hobbing operation. The first die produces a 0.644-inch diam cavity 0.550 inch deep in a solid copper blank. This cavity forms one end of the anode and acts as a guide for hob entry in the second die operation. Function of the second die is to produce 32 vanes which are the cause of machining difficulties in anode manufacture. Equally spaced at 11 deg 15 min, the vanes are only 0.015-inch thick.

Both the upper and lower dies, *Fig.* 3 are constructed to provide maximum rigidity during hobbing. Extra long guide pins maintain full die engagement throughout the entire machining cycle.

The lower die, constructed to hold the copper anode blank, consists of a hardened bushing shrunk into a soft steel yoke. Backed by a hardened steel plate, this assembly is fitted into a one-inch-deep counterbored pocket in the lower die shoe. The bushing, made of manganese-chrome-tungsten oil-hardening steel, is lap finished to provide a close fit to the workpiece. The yoke surrounding the steel is chrome-nickel molybdenum steel. Its depth is sufficient to enclose the entire anode.

In the upper die a stripper plate guided by four liner pins and backed by eight pressure pins is bolted to the shoe. A hardened steel bushing, mounted in the stripper, guides the hob as it enters the lower bushing. Extending one half inch beyond the face of the stripper plate, this bushing is matched to the lower bushing with a slip fit. In this way, upper and lower bushing engagement precedes hob entry into the blank. An air passage for removal of oil and dirt in the vanes of the hob is provided in the stripper plate. The air blast for cleaning the vanes is automatically triggered by a trip lever at the upstroke of the press.

To facilitate the removal of hobs for resharpening, two screw plugs are located in the top of the punch holder behind a hardened backing plate supporting the hob. The plugs permit hob removal without dismantling the die. This design greatly reduces the possibility of tool misalignment.

Hob Design: The hob used in the first operation is of comparatively simple design. The second, which forms the vanes, is also simple in design but difficult to make. Both hobs, *Fig.* 4, are made of Staminal steel or a commercial equivalent and are hardened to R_C 57-60.

Construction of the vane hobs requires milling 32 slots 0.015 inch wide. Workpieces are held in an optical dividing head while carbide cutters cut the slots, *Fig.* 5. Machined slightly undersize, the slots are polished before hardening, after which they are finish lapped with 200 grit diamond compound. Finishing the slots by grinding has proved less satisfactory than milling and polishing.

Approximately 0.020-inch stock is left on the outside diameter of the hob for grinding after hardening. However, before this diameter is ground, the hob's cutting action should be checked by pressing it into a soft copper blank approximately one

inch in diameter by one inch long. If the vanes created by this test pass inspection, the hob can be wet ground with a 32-A-100 (J6BCE) wheel. Maximum cuts of 0.0001 inch per pass provide the desired finish. The front of the hob can then be ground for sharpness. Feather edges resulting from grinding are effectively removed in hobbing the first part.

Hob maintenance is relatively simple. It is important that proper wheel selection be made for sharpening. After sharpening, the hob should be cleaned with a soft brush in soap and water. The copper build-up is not removed. After cleaning, the hob is dipped in acetone and dried. If it is not returned to service immediately, it should be stored in a plastic container with a rust inhibitor. Upon removal from the container, the hob is again cleaned with soap and water followed by an acetone rinse.

Preparation of the Blank: Proper selection of a blank material is of vital importance in hobbing anodes. Experiments have shown copper with an R_B reading of 48 to 60 to be most successful, although satisfactory results have been obtained from copper at full hardness. Copper in the low hardness range tends to cause a tearing of the vanes from the anode wall and makes deburring more difficult. The hardness of each blank is recorded for reference in the event the finished anode gives questionable results during cold turning.

Hobbing the Anode: When the hobbing die has been mounted in the press, the ram stroke is adjusted to permit rapid traverse to within ½ inch of the part. At this point, the ram speed changes to a slow traverse of 12 ipm. The hydraulic knockout which operates the ejection plug is set to travel to the top of the lower die yoke which nests the blank.

Before a blank is placed in the die, it receives a coating of castor oil used because of its good lubricating qualities. Castor oil also prevents part contamination which other oils might cause. Excessive use of lubricant is undesirable because it is occasionally trapped in the cavity, causing variations in part size.

After hobbing, the parts are inspected for size and concentricity. Cavity diameter must be held within 0.0005 inch and concentricity to 0.0003 inch TIR. Because of the displacement of metal caused by hobbing, a subsequent machining operation is required to remove excess material and provide an end surface parallel to the bottom of the

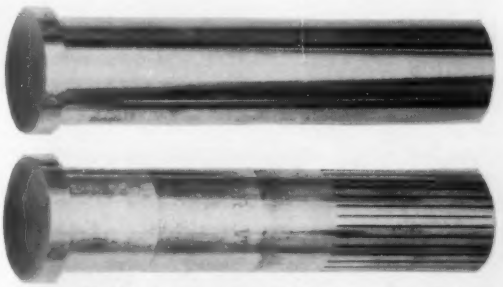


Fig. 4. Hob at top forms preliminary cavity. Bottom hob forms the vanes. Except for manufacturer of vane hob, tooling is comparatively simple.

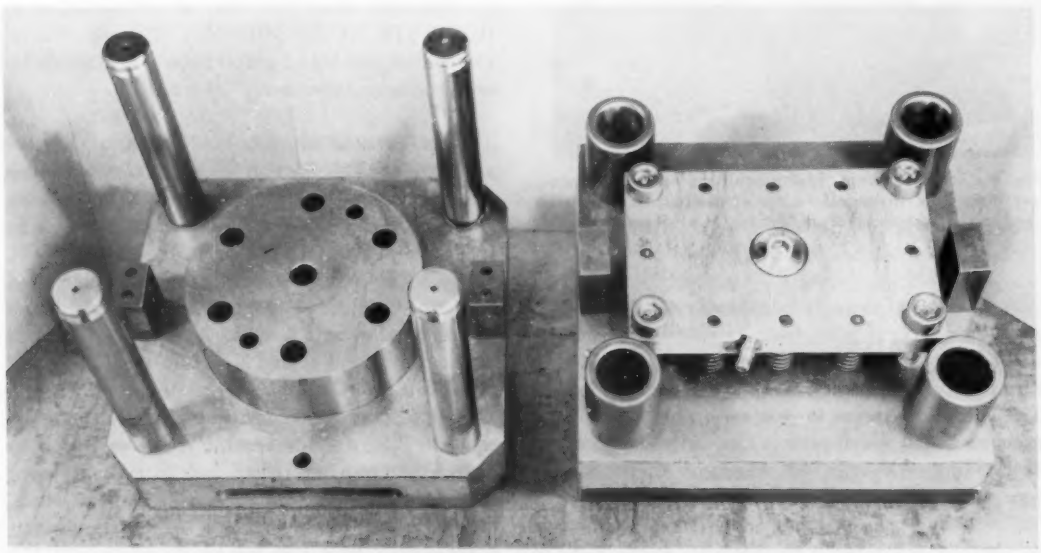


Fig. 3. Vane-hobbing die ready for assembly. Bushing in stripper plate, designed to fit yoke bushing, supports hob throughout machining operation.

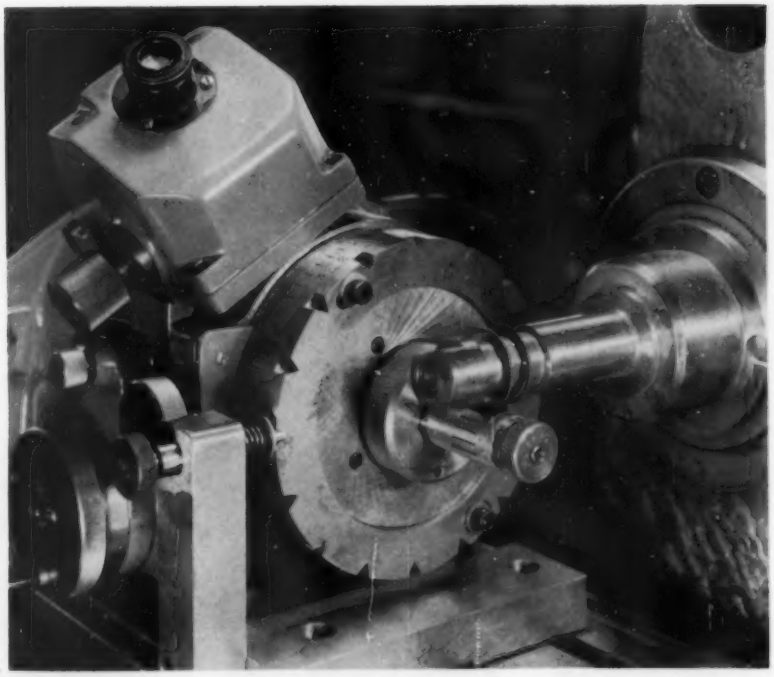


Fig. 5. Slitting the vanes in a second-operation hob. Except for polishing after hardening, vanes are finished in this operation.

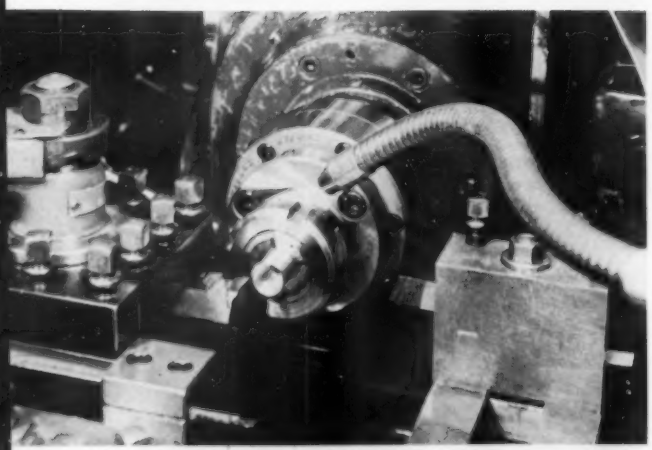


Fig. 6. After hobbing, final machining operations are performed in turret lathe. Epoxy resin, cast between the vanes, supports them during machining.

part. Growth of the part is approximately ¼ inch, of which 1/16 inch is removed by machining.

When the second hobbing die is set up, ram pressure is set at 32 tons and bumper pins are removed. This allows the press to operate on an automatic pressure cutout which protects the vane hob against overloading. Although ram speeds of 12 ipm have been used without difficulty, slower speeds reduce hob wear and permit a better flow of copper.

When die setup has been made, an anode blank hobbed in the first operation is placed in the die nest. Its cavity is flooded with oil and press operation is initiated. Flooding is permissible when hobbing the vanes because the slots in the hob permit oil escape. After hobbing, the part is removed and the vane depth measured. Errors in depth can be easily corrected by increasing or decreasing ram pressure. If preliminary inspection with a 20-power microscope shows correct vane formation and tool alignment, a sample part is checked on a comparator with a reflection attachment and special chart. Concentricity of all diameters is again checked to 0.0003 TIR. If the part meets all inspection requirements, the hobbing operation is continued. Inspection is repeated every 20 parts.

Heat Treatment: After inspection, anodes are annealed at 932 F for four hours in a dry hydrogen atmosphere. In addition to relieving hobbing stresses, the annealing process permits vanes to be readily adjusted during cold tuning of the anode. Unannealed anodes, although easy to machine and deburr, are difficult to cold tune because the vanes spring back when adjusted.

When the anodes have been cold tuned, they are filled with epoxy and baked at 150 F for 16 hours. This is to cure the epoxy and give it a hardness equal to that of the copper. Purpose of this is to protect the vanes and reduce burr formation during subsequent machining operations on turret lathes, *Fig.* 6. After machining, the epoxy is removed ultrasonically in a sulfuric acid solution and the anodes are deburred for final inspection.

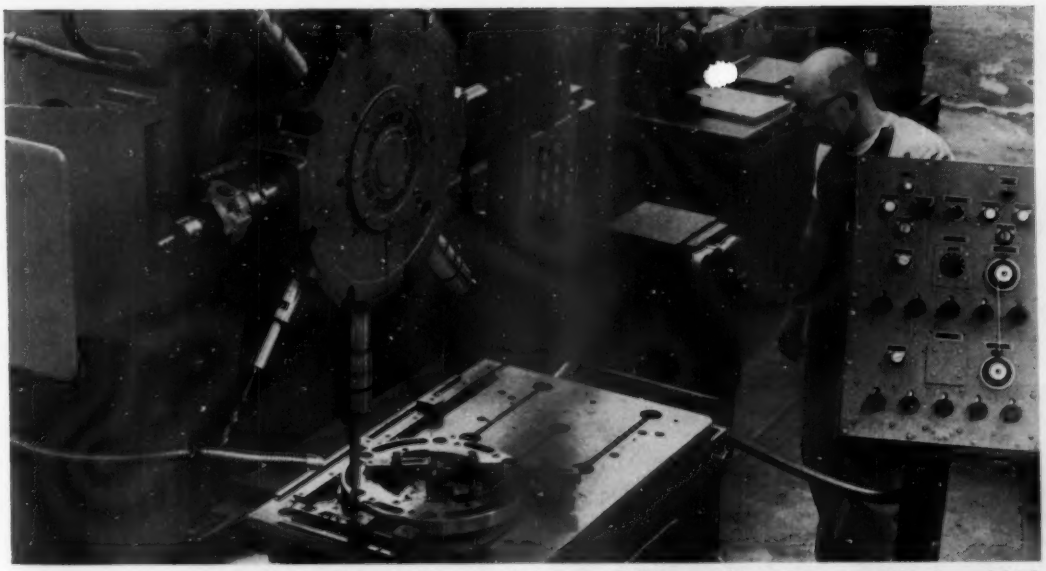


Fig. 1. Numerically controlled turret drilling machine gives a combination of high production and versatility that is required for efficient job-shop machining.

High-Production Job Shop

—a new concept in manufacturing

By T. W. Black
Senior Associate Editor

With the versatile machines, tools and equipment available today, mass production efficiency is possible in job-lot production. Creative manufacturing engineering has made this potential efficiency a reality at a new Westinghouse plant making power circuit breakers.

MANUFACTURE OF THE DEVICES used in high-voltage power distribution systems is a highly competitive business. There are several producers of this type of equipment and foreign manufacturers are entering the field in greater numbers.

Given a good product, the key to meeting this competition is greater manufacturing efficiency. At the new Westinghouse plant at Trafford, Pa., progressive assembly, mechanized parts handling and automation, *Fig.* 1, have revolutionized the manufacture of massive power circuit breakers, proving that high-production methods can be successfully applied to short-run or job-shop operations.

Planning Team: Manufacturing lines in the new plant were planned by 30 teams or committees under the general direction of a superintendent of facilities planning. Each team was responsible for specific areas in the plant. The objective of this approach was to take advantage of the experience and skills of all of the manufacturing personnel concerned. The foreman who would ultimately be in charge of production in each area served as chairman of the team. Other members included industrial engineers, manufacturing engineers and staff supervisors. Individual plans were integrated and coordinated by the facilities planning superintendent.

All production planning for the plant was toward the development of manufacturing techniques that

would permit one step toward automation from typical job shop operation. In carrying out this philosophy, the entire plant was planned without the use of a single conventional drawing. Instead, three-dimensional scale models of machines, handling equipment and workpieces were used. This technique made it possible to plan the internal flow and storage of materials as well as the location of machine tools.

Planning was complicated by the fact that circuit breakers are made in a variety of sizes and capacities. Consequently, handling equipment and fixtures had to be designed with sufficient versatility to accommodate parts and assemblies in a wide range of sizes. Further, the possibility of product design changes had to be considered. Most of the circuit breakers in use today, for example, employ oil as an interrupting medium, *Fig.* 2. Future circuit breakers, some of which are now in production, will employ sulfur hexafluoride gas as an interrupting medium. At the time the plant was being planned, however, the new types of breakers had not been completely designed.

Another consideration in planning was the long-range growth of the need for electric power in this country which, of course, creates a need for more circuit breakers. Electrical power requirements double every 10 years so the planning teams were faced with the problem of "designing in" the capability for future increases in production volumes.

Fig. 2. Power circuit breaker during final assembly. It is moved from station to station by a chain-drag conveyor. These circuit breakers, which weigh up to 22 tons, consist of three tanks mounted on a common frame. Each tank contains a separate breaker mechanism.

Tank Line: Most circuit breakers consist of three circuit-interrupting devices, each immersed in three separate tanks filled with oil, compressed air or sulfur hexafluoride under pressure. In a typical job-shop operation, these tanks would be assembled on a stationary buck and manually welded. In the new plant, however, these tanks are fabricated in a number of progressive stations connected by gravity conveyors and much of the welding is automatic. Powered cradle rolls at each station rotate each tank for processing. After operations at the station are completed, air cylinders lift the tank onto the conveyor. There are two tank fabrication lines; one accommodating tanks from 24 to 50 inches in diameter, the other, tanks greater than 50 inches in diameter. Tank heights range from 31½ to 110 inches.

The tanks are made from sheet steel that is cut to size on a shear and then pinched-rolled into a cylin-

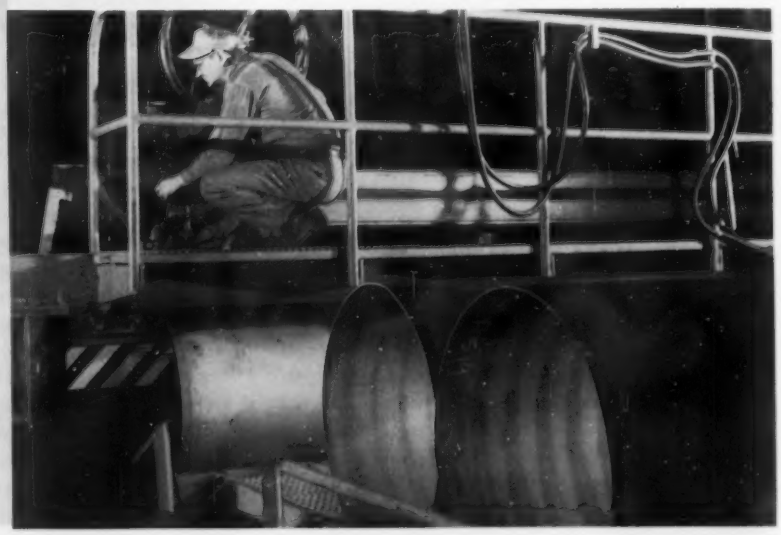


Fig. 3. (right) Operator positioning welding head for automatic welding of tank seam. Weld speed in ¼-inch stock is about 24 ipm.

drical shape and tack-welded. From the pinch rolls, the tank shell is moved to the load platform of an automatic self-charging shot-blast machine. After the tank shell in process is shot-blasted and ejected, the waiting tank shell rolls by gravity into the chamber and the doors close. The tank shell revolves on cradle rolls while a stream of shot from nozzles on a moving boom blasts both internal and external wall surfaces. Upon completion of shot-blasting, the boom advances again to airblast any remaining shot from the tank. At the end of the cycle, exit doors open automatically and the cradle rolls elevate and tilt forward, feeding the tank along the gravity conveyor to an automatic seam welder, *Fig.* 3.

At this station, the tank shell is rolled into position on cradle rolls, is rotated to move the longitudinal seam into proper position and is seam-welded by the submerged-arc process over a heavy copper backup bar. After welding, the tank moves by gravity to the next station, where the tank bottom is fitted and tack-welded within the tank and then to another where an automatic welding head makes a peripheral seam weld to join the tank bottom to the tank, *Fig.* 4.

The West-Ing-Arc process is used. In controlling the process, the operator advances the welding head until the welding wire makes contact, then presses a button that initiates welding and causes the tank shell to revolve. During the process, an automatic seam follower keeps the head in position. After the weld is completed, the operator presses a single pushbutton to halt the process and eject the tank shell to the discharge conveyor. Similar equipment is used at the next station to weld the internal peripheral seam.

Domes for the tank are prefabricated in an area just off the tank line. They are produced on a five-station carousel whose assembly fixtures are suspended from an independently powered overhead monorail conveyor by carriers that can be tilted to facilitate down-hand welding, *Fig.* 5.

After a dome is assembled and welded on its fixture, the carrier bearing both dome and fixture is advanced into position at the front of a rail-truck and the fixture and dome are bolted to the truck, *Fig.* 6. When indexed to a height corresponding to the diameter of the tank, the truck is driven forward on its rails, then halted until motor-driven clamps on the truck squeeze the tank into true circular shape. When the tank has been rounded, the truck moves the dome forward into precise position for welding. On completion of the weld, the fixture is moved and remounted on its carrier for assembly of another dome.

The tank moves to the succeeding station, *Fig.* 7, where a circular manhole is burned into the tank wall with an oxyacetylene cutting torch on a rotating arm whose movement is controlled by two templates. Use of this ring as template for control over radius of cut has made it possible to eliminate discrepancies in fit-up caused by individual variations in tank roundness. The second template

Fig. 4. As tank is revolved, the tank bottom is automatically welded to the side.

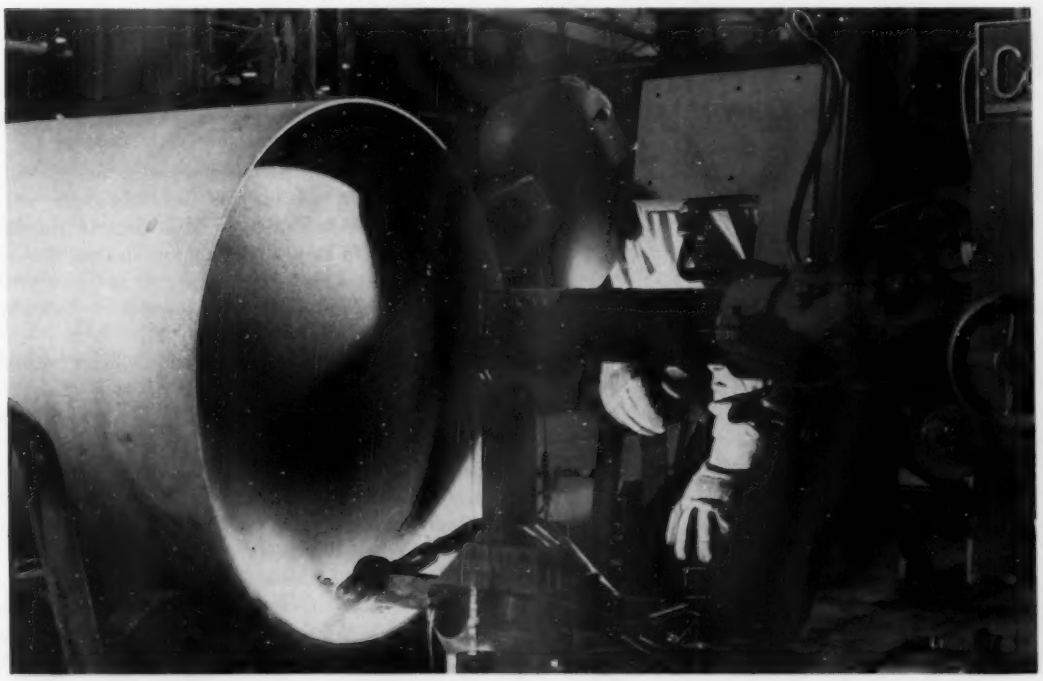


Fig. 5. Fixtures for assembly of dome tops are carried from station to station by an overhead conveyor.

Fig. 6. (below) Tank dome is positioned for welding to tank shell by a railed truck.

controls in-and-out motion of the cutting head so that the cutting flame is always at the proper distance from the tank wall. At a subsequent station, various metal parts are welded into place. Then the tank is leak-tested and three tanks are grouped and aligned on the heavy steel beams that form the foundation for the circuit breaker.

Use of the progressive line and automatic welding has substantially improved productivity over traditional job-shop methods, and illustrates a basic approach to job-shop mechanization. This approach is to provide versatile equipment so that similar products can be processed on the same line.

Machining Centers: Circuit breakers contain a large number of precision-machined parts. Most of these parts are finished in machining centers, in which machines of various types are pooled at one location to do all machining necessary on parts for specific product lines. By this departure from earlier practices—in which machines of similar types were grouped together, as in most job shops—it has been possible to reduce materials handling substantially.

Concentrated at one location, for example, are five programmed, multipurpose machine tools of three types: two Warner & Swasey Number 3 automatic chucking lathes, two Burgmaster multispindle tape-controlled turret drills, *Fig.* 1, and a Milwaukee-Matic tape-controlled combination milling and drilling machine.

At this center, repeat orders are quickly put into production by loading the numerically controlled machines with programs kept on permanent file for each job. So far, programs for 16 different parts have been developed for the milling-drilling machine and for 51 parts on the turret drills. Production experience with these machines indicates that tape control is economically feasible for lots as small as 12 parts.

One of the principal advantages of the tape-controlled drilling machines is their ability to work without elaborate drill jigs. Most fixtures are simple plates with stops and clamping devices that locate the part accurately and permit accurate positioning of the holes with the numerically controlled positioning of the worktable.

The tape-controlled milling and drilling machine is capable of selecting and automatically changing up to 961 different coded tools. The only limitation on tool size is that for automatic loading, tools must be less than 2⅝ inches in diameter and not more than 7½ inches in over-all length from the spindle face. Larger tools can be accommodated in the machine but must be hand-loaded.

Generally, the size of the part than can be machined on this tool is limited to an 18-inch cube. The system provides point-to-point positioning along three axes, controlled positioning of the

workpiece in any of eight positions 45 degrees apart and control of spindle speeds from 100 to 4000 rpm in 10-rpm increments. Feed rates on any of the three axes are controlled by tape from one ipm to 99 ipm in one-ipm increments.

By purchasing this single machine, Westinghouse eliminated the need for purchasing three radial drill presses and two milling machines. While this resulted in a virtual standoff so far as capital investment was concerned, substantial economic benefits were obtained through reductions in floor space, tool cost (both expense and fixturing), cost of setup, and cost of inspection and handling of parts. Lead time for the production of new part designs has also been substantially cut.

Progressive Assembly: Bench assembly operations, typical of most job shops, have been replaced by progressive assembly lines in the new plant, *Fig.* 2. High-voltage and low-voltage breakers are assembled on separate multistation conveyorized assembly lines, with the personnel at each station responsible for only one phase of the total final assembly operation. Previously, both types of breakers were assembled at one site and all individual operators in the assembly group had to be qualified to perform any and all operations.

With the new assembly method, components can be delivered to the exact point of use. Since each operator specializes in one phase of assembly work, formal instructions can be kept to a minimum. Typically, these instructions are a simple outline of the sequence in which parts are to be mounted. The outline usually consists of eight or ten numbered steps, typed in about 150 words on a single sheet. Protected by transparent plastic, these sequence outlines are mounted at work stations on clip type posting boards so that they can be changed easily as job requirements change.

At the start of the final assembly line for frame-mounted, medium-voltage breakers, the breaker top is built up as an inverted subassembly on a free-roller conveyor. The two upright ends of the breaker structure are built as subassemblies at other points. After the top is completed, a crane-tilted turnover fixture, *Fig.* 8, moves it through 180 degrees into the right-side-up position, preparatory to mounting it upon the two frame ends. For mounting, the frame is transferred to an adjustable clamping and welding fixture that accepts any of the four standard frames built on the line. After welding, the breaker is transferred on a wheeled dolly to subsequent assembly and test stations by an in-floor drag chain.

During the short period the plant has been in operation, the expected benefits from the use of versatile tooling and machines, and progressive assembly lines, have been fully realized. The total time cycle required to produce a completed circuit breaker has been reduced by 80 percent as compared to the previous job-shop methods. There has also been a 50 percent increase in productivity per unit of floor space.

Westinghouse manufacturing engineers feel, however, that the operations in the plant are capable of further improvement. Manufacturing research programs are conducted on a continuing basis. New methods and equipment are installed constantly. Consequently, the plant should be as up to date 10 years from now as it is today.

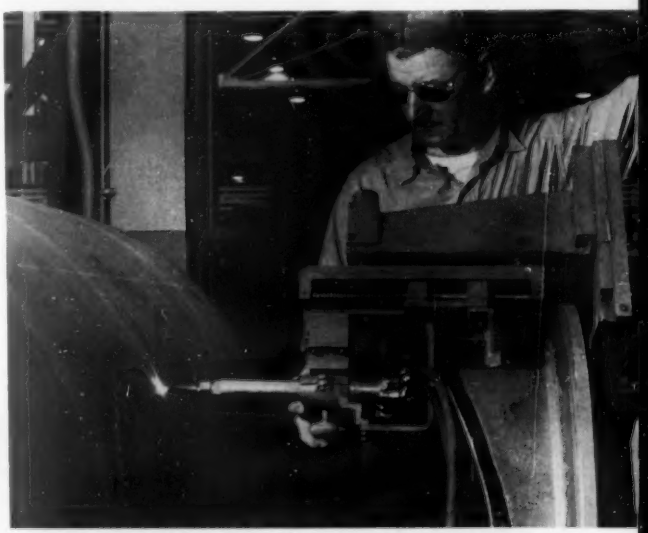


Fig. 7. Manhole flange is used as a template to guide torch that burns out manhole in tank. The flange will later be welded to the tank.

Fig. 8. Assembly line for circuit breaker tops. The tops are assembled in the upside-down position, then turned over by the fixture in foreground.

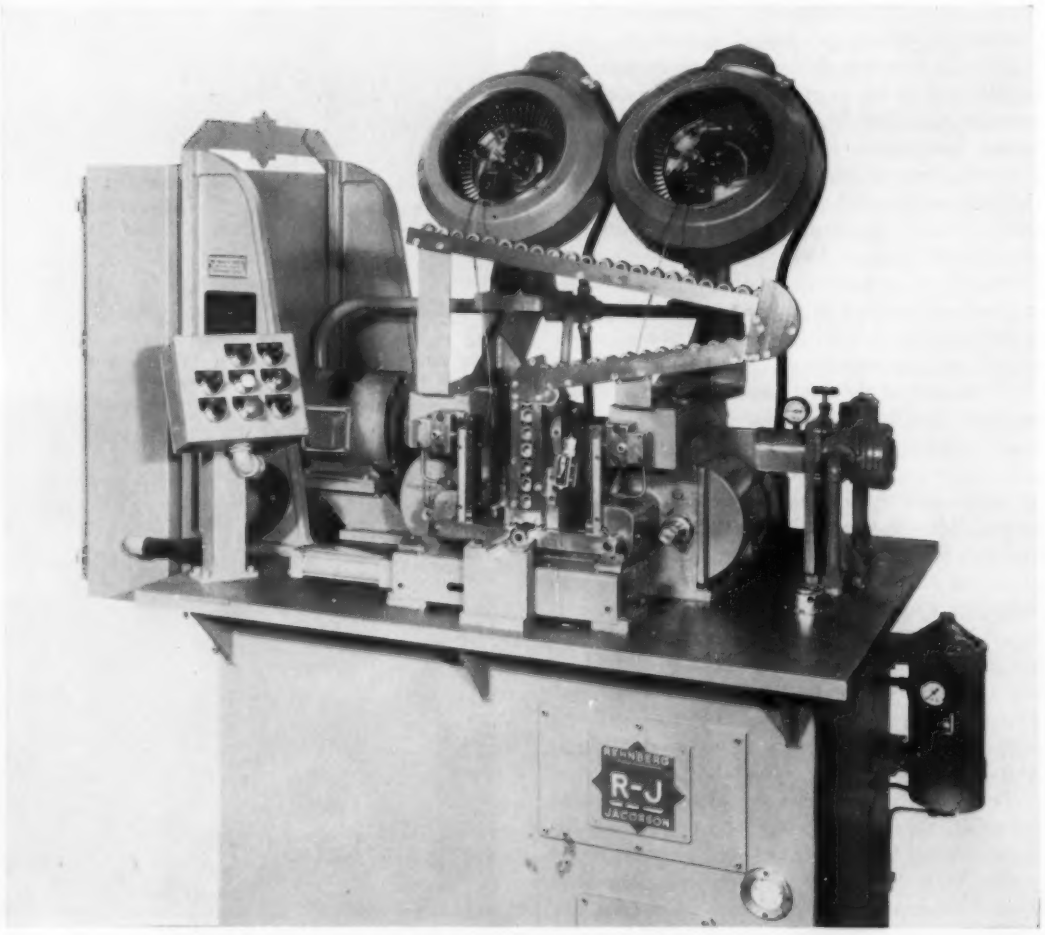
designed for

PRODUCTION

Assembles 2200 Gears per Hour

Working at 100 percent efficiency, the special machine illustrated completes 2200 needle roller assemblies per hour. Equipped with two assembly fixtures—one at each end of a hydraulically operated slide—the unit completes one assembly while ejecting another.

In operation the machine utilizes two Rehnberg-Jacobson rotary hoppers and a magazine to feed needle bearings and gears to work areas. Entire machine cycle is automatic including lubrication of gears before assembly.



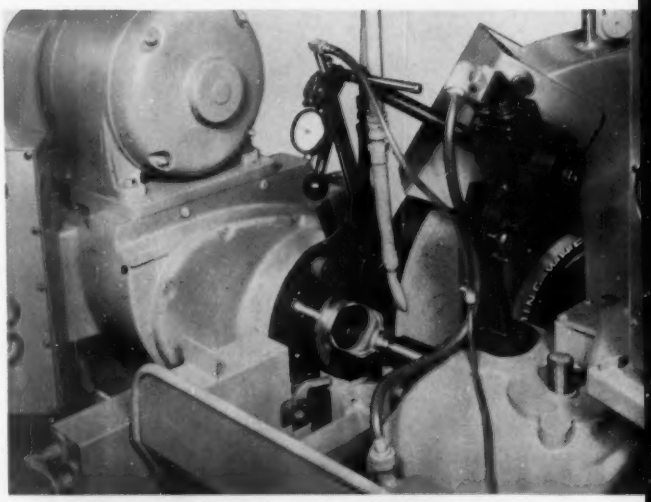
AUTOMATIC MACHINE
Grinds Shoulders and Shafts Simultaneously

Sizing adjustments as fine as 0.00005 inch are possible on this Cincinnati angular wheel slide grinder. The infeed screw is hydraulically driven.

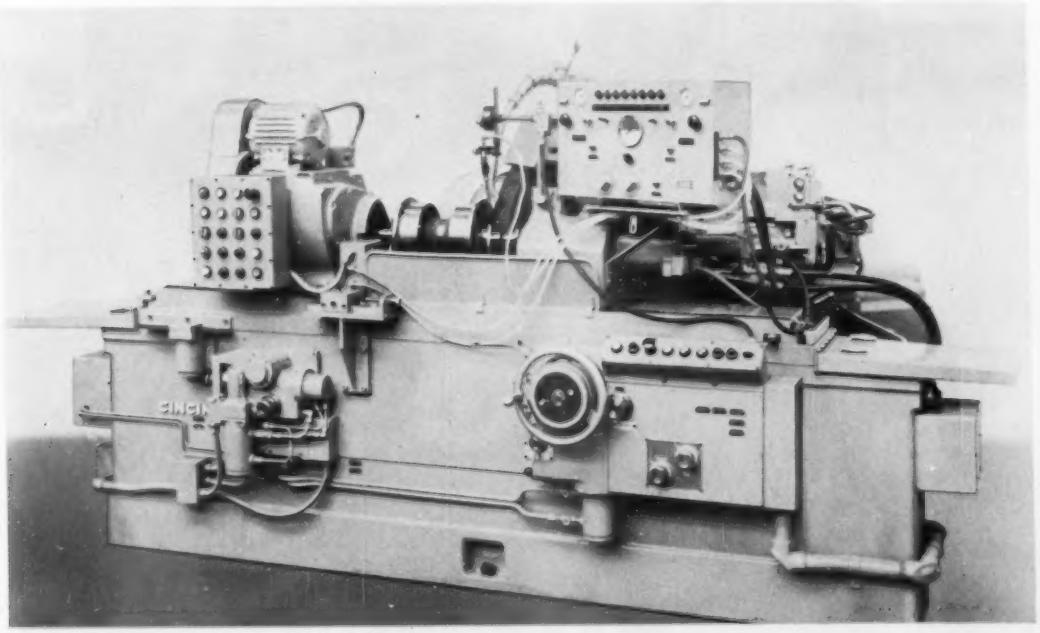
Fully automatic operation is possible. When the grinder is set for automatic operation, pressing the wheel head advance button initiates a complete cycle that hydraulically clamps the table, rapidly advances the wheel head, starts work rotation, grinds at fast feed rate, grinds at flow feed rate, tarries, rapidly returns the wheel head, stops work rotation and unclamps the cycle. With the addition of an air-electric gage, the grinding time cycle is automatically corrected for wheel wear.

Since feeds are at an angle, a circular line finish, instead of a criss-cross finish, is obtained.

Behind-the-wheel profile truing is cam-controlled. From two to 10 diamond passes can be selected, with truing in both directions if desired. The device can be set to true the wheel after a predetermined number of pieces have been ground.



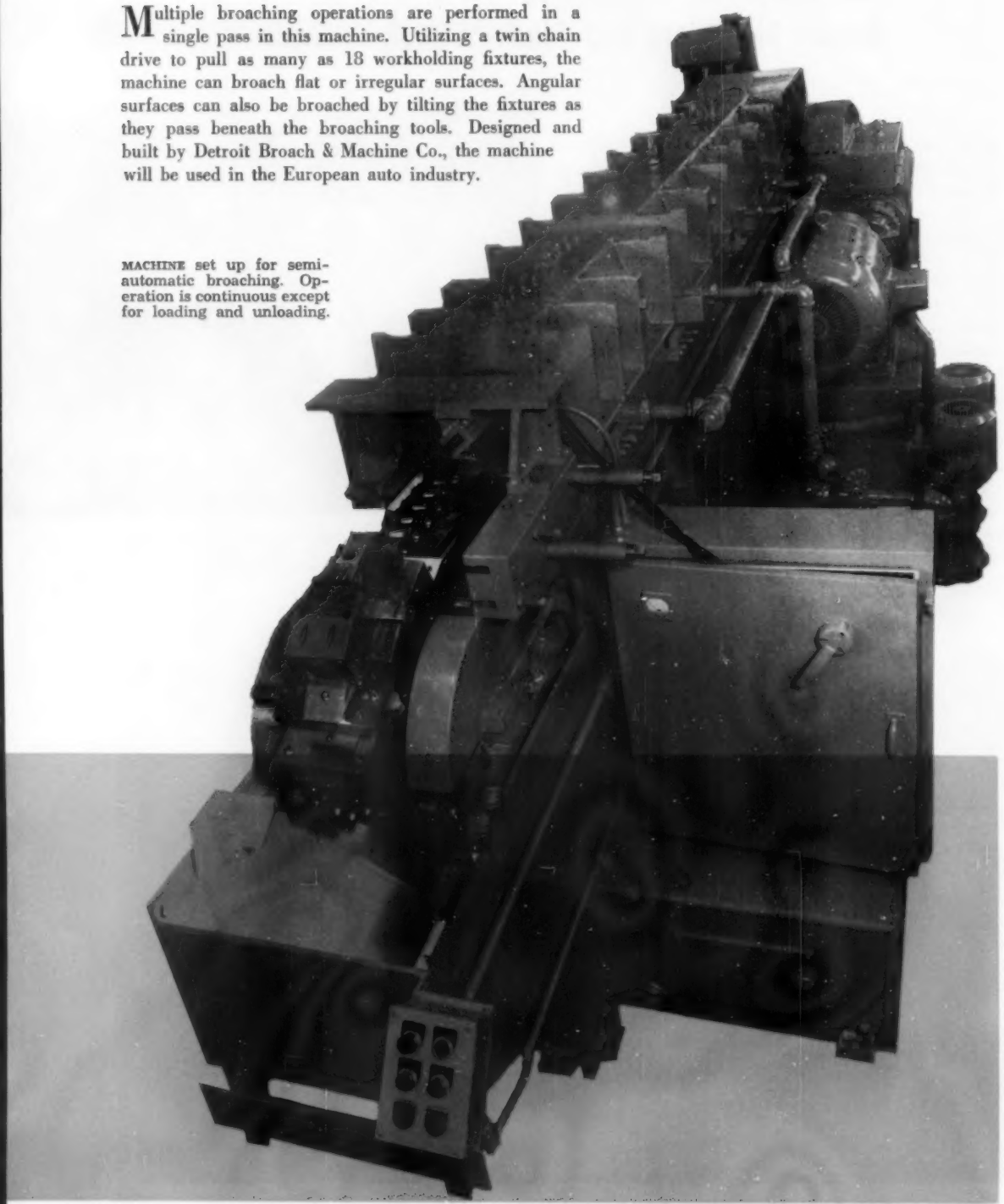
TWO WIDELY varying diameters and the adjacent faces are ground simultaneously on this angular wheel slide grinding machine. A flagging device locates the work axially.



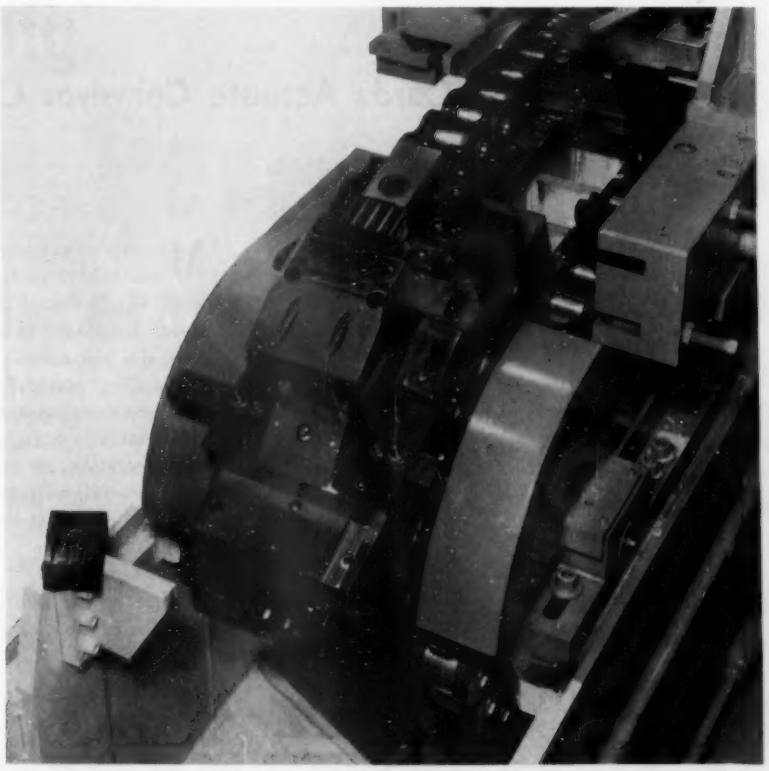
ANGULAR WHEEL slide grinder has pushbutton controls for fully automatic operation.

Tunnel Machine Automates Broaching

Multiple broaching operations are performed in a single pass in this machine. Utilizing a twin chain drive to pull as many as 18 workholding fixtures, the machine can broach flat or irregular surfaces. Angular surfaces can also be broached by tilting the fixtures as they pass beneath the broaching tools. Designed and built by Detroit Broach & Machine Co., the machine will be used in the European auto industry.

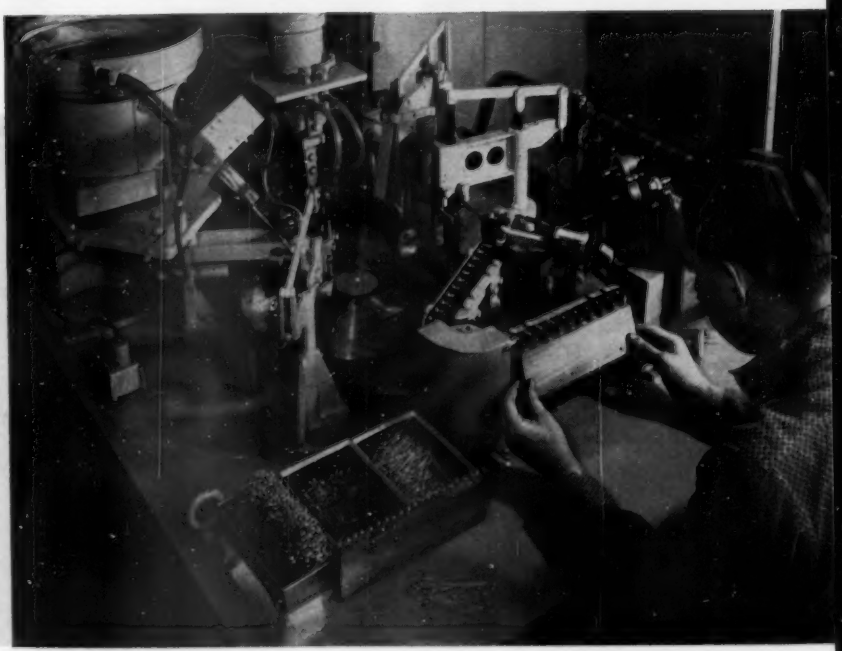


MACHINE set up for semi-automatic broaching. Operation is continuous except for loading and unloading.



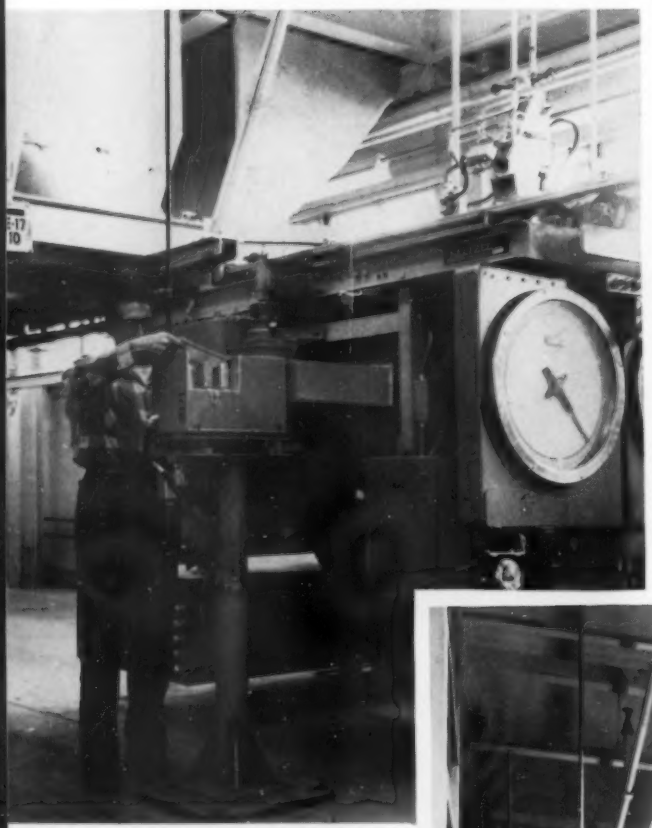
FIXTURE used to carry workpiece through machine. Machine can be easily retooled for different parts.

Parts Welded in Controlled Atmosphere



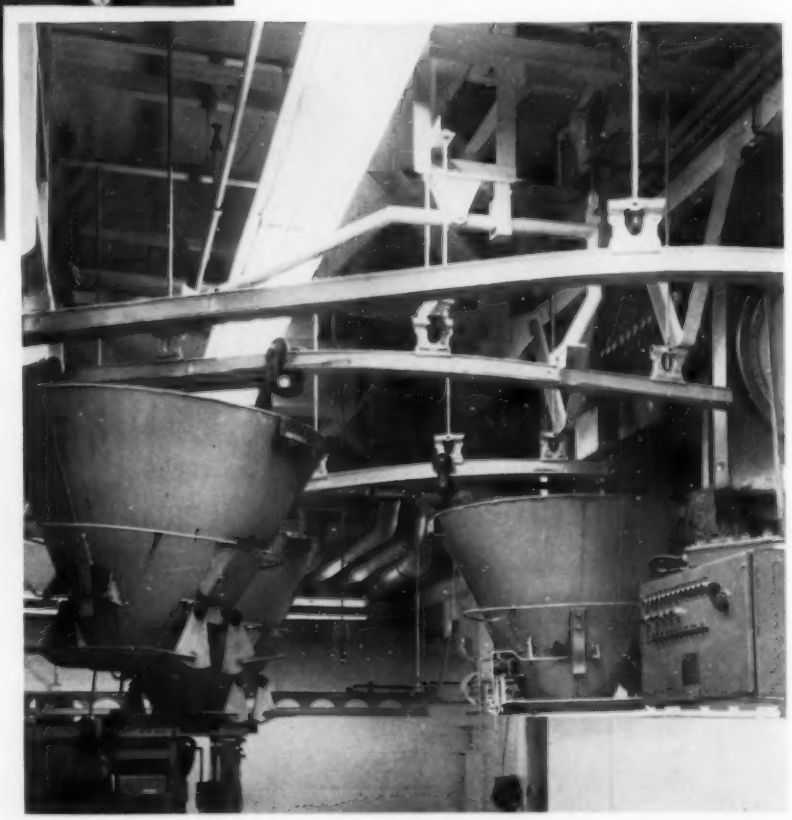
Parts loading, assembly, in-station inspection, welding and part ejection are all automatic functions of the machine illustrated. Designed for welding transistor components, the entire unit is encased in a controlled atmosphere dry box when in operation. This special machine, manufactured by Precision Welder and Flexopress Corp., Cincinnati, is an adaptation of the company's standard line of welders.

Punched Cards Actuate Conveyor Carriages



Mixtures of abrasive grain and bonding materials are held to uniform consistency by a punched-card control system in a newly opened Norton Co. plant. Variables controlled by the cards include type, size and amount of abrasive, type and amount of bonding material, mixing station designation, supplementary operator instructions, and payroll information.

In operation, the cards are mechanically inserted into monorail carriages, which can be stopped at any one of a number of loading and unloading stations. Hoppers carried by the carriages are loaded and discharged according to commands punched on the cards. Upon discharge of the hoppers, the carriages return to the starting point and the control cards are filed as permanent records.



Operator (above) loading control-card dispenser. Mechanical insertion of card into carrier initiates automatic conveyor cycle.

Hopper (right) discharged at mixing station. Carriage is raised to this point by movable monorail section which elevates according to card command.

obtaining High Performance from ceramics and carbides

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Economies in the use of ceramics stem from high metal removal rates and improved finishes, but in some cases carbides can perform better. Tests conducted by the authors can help in selecting optimum cutting tools and cutting conditions.

CERAMIC TOOLS can remove from two to four times the volume of metal that carbides can during the life of the tool and at higher speeds, as shown in *Fig.* 1. In other cases, carbides are more suitable than ceramics. Metal removal or tool life as indicated in *Fig.* 2 can serve as a major criterion for selecting machining conditions. Good machining practice is necessary when using carbides and is even more critical when using ceramics because of their brittleness. Performance parameters that affect cutting conditions are examined in critical detail in this article to provide guidance in selecting appropriate conditions for cutting with either ceramics or carbides.

Test Range and Conditions: Effects of cutting conditions that were investigated include tool forces and temperatures, cutting forces related to cutting speed, chip thickness ratios, chip contact areas, variations in tangential cutting force and feed force related to cutting speed, rake angles, cutting temperatures related to cutting speeds and rake angles, power consumption and energy required for different rates of removal.

Workpieces of AISI 1015 seamless tube, 120 Bhn average, were premachined to a 6-inch OD and a wall thickness of 0.100-inch, ± 0.001 inch. Length of each test bar was about 10 inches at the start and 4 inches at the end of cutting. Each workpiece was accurately centered in a three-jaw chuck on a 20-inch Reed-Prentice engine lathe. Each test cut, run dry in air, was started with a workpiece temperature of 70 F. A specially designed toolholder was mounted in a three-component SR-4 strain gage dynamometer, output of which was fed through a BL-320 Universal analyzer to a BL-201 and BL-202 oscillograph.

Orthogonal turning tests were carried out in the Mechanical Engineering Laboratory of the University of Wisconsin. Feeds of 0.005 and 0.010 ipr and cutting speeds of 150, 200, 300, 400, 500 and 600 fpm were used. Cutting speed was limited to a maximum of 600 fpm primarily because of the difficulty of handling the chip ribbon at higher speeds. No chip breaking action was permitted since this would have influenced the cutting force values. Duration of cutting in the tests usually ran from 10 to 50 seconds, but in some tests longer periods of cutting time were used to observe the influence of wear on the magnitude of the forces.

Both carbide and ceramic tips, $\frac{3}{4}$ x $\frac{3}{4}$ x $\frac{3}{16}$ inches were used. Clamped atop a carbide support plate in the toolholder, they were ground to back rakes of −10, −5, 0, +5, +10 deg and an end

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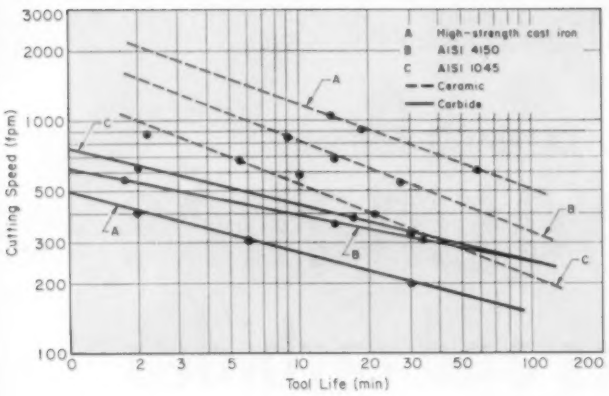


Fig. 1. Ceramic tools perform better at the higher speeds, carbides at the lower speeds.

clearance of 10 deg. The axis of the tubular workpiece and the cutting edge were located in the horizontal plane passing through the workpiece axis within 0.030 inch. All cutting edges were closely examined under 20× magnification to eliminate tips with chipping and grinding defects. They were given one smoothing pass with an oil stone in a direction parallel to the edge and normal to the plane bisecting the included angle between the rake and clearance faces. Each chip-tool contact area was photographed at magnification of 22× and the contact length was measured from the photograph to assure good accuracy.

Cutting Forces: Cutting forces were practically the same for ceramic and carbide, Fig. 3. Differences amounted to less than 5 percent and in some cases ceramic tools involved slightly greater cutting forces than carbide tools. As shown for ceramic tools in *Fig.* 3*a*, cutting force using negative rake angles decreased as cutting speed was increased from 150 to 350 fpm. The same was true for carbide tools. Above 350 fpm the curves flatten out, total change is less than 10 per cent. Results obtained at feeds of 0.010 ipr are typical, though with more positive rake angles at a feed of 0.005 ipr the curves were flatter. Repeated force measurements were necessary at speeds of 150 and 300 fpm to obtain consistent average force values as measurements fluctuated at these lower speeds. At higher cutting speeds, cutting forces were steady.

Chip-Thickness Ratio and Shear Angle: Since the ratio of width-of-cut to feed in these tests was either 10 or 20, the mechanism of chip formation can be treated as a problem of plane strain, at least for the central section of the chip, so that the relation expressed by Equation 1 applies.

$$\tan \phi = \frac{r_c \cos \alpha}{1 - r_c \sin \alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The chip-thickness ratio decreased (that is, the chip thickness increased) as the rake angle varied from positive to negative and as the cutting speed was decreased. Chip-thickness ratios were also consistently lower at 0.005 ipr than at 0.010 ipr. Shear angle relations, shown in *Fig.* 3*b* behaved in a similar fashion and were not greatly influenced by the type of tool material. Chips produced by carbide and ceramic tools under the same conditions are different in appearance but this difference can be attributed to temperature effects.

Chip-Tool Contact Area: As shown in *Fig.* 3*c*, chip contact area is influenced by feed, speed and rake angle. Greater areas were obtained with car-

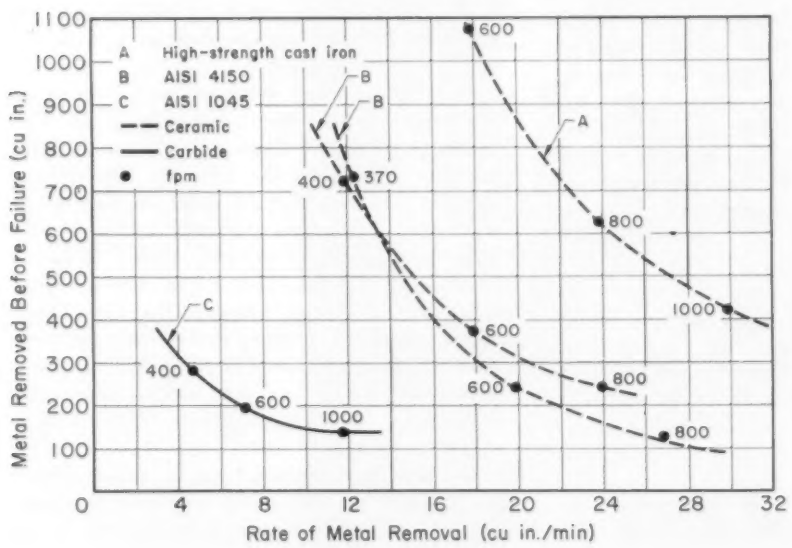


Fig. 2. Rate of metal removal or tool life can be used to select tools and cutting conditions.

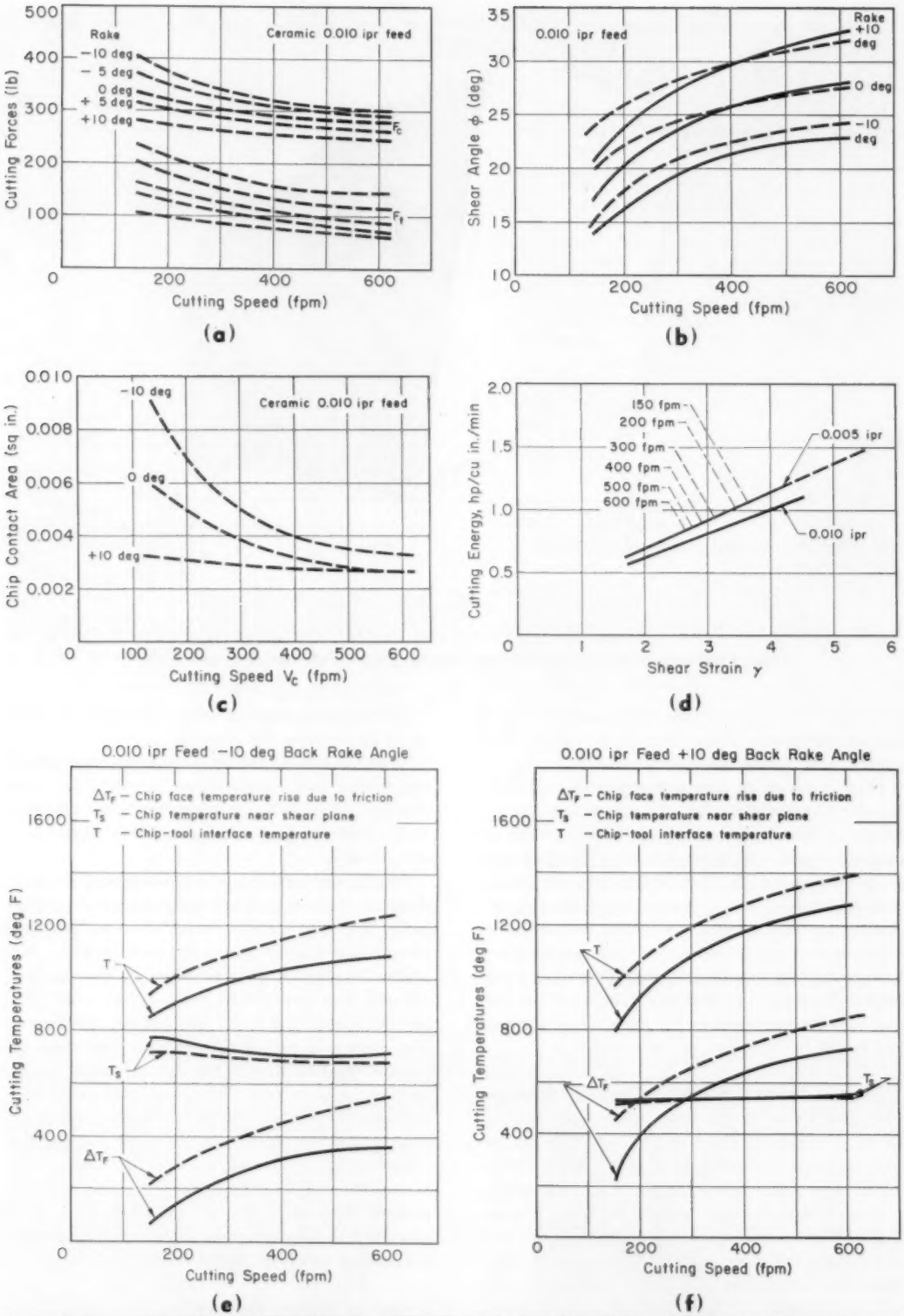


Fig. 3. Performance of carbide and ceramic tools is affected by force temperature, shear angle, energy and chip contact area. Workpiece material is AISI 1015 120 Bhn tube.

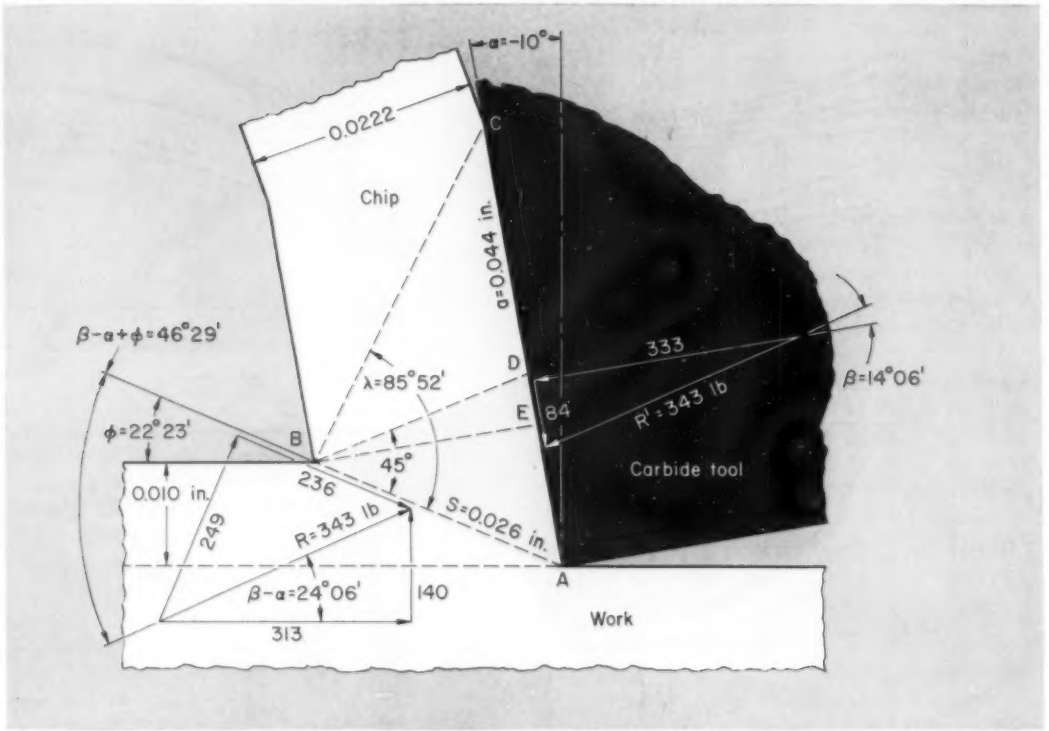


Fig. 4. Geometry and forces affecting carbide cutter with 10-deg negative rake.

bide tools than with ceramic tools under the same cutting condtiions. This difference in area tends to diminish as cutting speed increases.

From a survey of current theories of angle relationships in metal cutting, it appears that the behavior of the chip in sliding over the contact area cannot be satisfactorily explained by the ideal plastic solution alone. A limited portion of the contact area is involved in the formation of the chip according to the ideal plastic solution, the remainder of the contact occurs under elastic stress conditions. It appears that significant clues regarding catastrophic breakage or structural failure of the cutting edge are contained in the variation of the contact length or area between chip and tool.

Shear Stress, Strain, Cutting Energy: The shear stress on the shear plane was found to be on the average about 96,100 psi at 0.005 ipr and 90,300 psi at 0.010 ipr. Average shear stresses for ceramic were slightly higher than for carbide. Computed data indicate a minimum shear stress of 81,000 psi in the shear zone with a carbide tool at 150 fpm, 0.010 ipr and a 10-deg positive rake. Maximum shear stress of 113,600 psi occurs with a carbide tool at 150 fpm, 0.005 ipr and a 10-deg negative rake, *Fig. 3d*. Since the static shear flow stress for AISI 1015 is approximately 26,000 psi, these experiments indicate that shear flow stresses in the shear zone are three to four times the static shear flow stress.

Shear strain decreases with increasing cutting speed and feed. It increases as the rake angle changes from positive to negative. Average shear strain with carbide tools was slightly higher than with ceramic.

Specific cutting energy is proportional to shear strain at a given feed and is greater at the lighter feed. Specific cutting energy for carbide and ceramic are approximately the same and the data plotted in *Fig. 3d* apply to both. As the rake was changed from positive to negative and as the feed was decreased from 0.010 to 0.005 ipr, specific cutting energy increased. As cutting speed was increased, specific cutting energy remained nearly constant or decreased slightly with the more positive rake angles but decreased by as much as 30 percent with the more negative rake angles. For either carbide or ceramic tools, values ranged from a minimum of 0.62 hp per cu in./min. (10-deg positive rake at 0.010 ipr and 600 fpm) to a maximum of 1.55 hp per cu in./min. (10-deg negative rake at 0.005 ipr and 150 fpm).

Cutting Temperatures: Chip temperature near the shear plane was higher for the carbide than for ceramic with 10-deg negative rake angle tools. As cutting speed was increased from 150 to 400 fpm,

Nomenclature

A = Area factor
a = length of contact, in.
b = width of cut, in.
c_1 = specific heat of workpiece, Btu/lb deg Fahr
F_c = tangential or cutting force, lb
F_f = friction force, lb
F_t = thrust or feed force, lb
J = mechanical equivalent of heat, 9339 in-lb/Btu
K_1 = workpiece thermal diffusivity, sq in/sec
K_2 = thermal diffusivity of chip at resultant temperature T
k_2 = chip thermal conductivity at resultant temperature T, Btu/sq in sec deg Fahr/in.
k_3 = tool thermal conductivity at resultant temperature T, Btu/sq in sec deg Fahr/in.
$L_2 = \dfrac{V_f\, a}{4\, K_2}$ a dimensionless number
$M = \dfrac{F_f\, V_c\, r_c\, A}{J_b\, k_2}$
$q_f = \dfrac{F_f\, V_f}{J_{ab}}$ friction energy dissipated at chip-tool interface, Btu/sq in/sec
q_s = quantity of heat generated in shear zone, Btu/sq in/sec
q_w = quantity of heat going to workpiece, Btu/sq in/sec
R = See Equation 6
R_1 = fraction of q_s transferred to chip
R_2 = fraction of q_f going to chip
r_c = chip thickness ratio
$s = \dfrac{t_1}{\sin \phi}$ length of shear plane, in.
T_a = workpiece or room temperature, deg F
T_s = chip temperature due to shear, deg F
t_1 = feed, ipr
V_c = cutting speed, ips
V_f = chip velocity, ips
α = rake angle
β = angle of friction
γ = shear strain
ΔT_f = temperature rise due to friction, deg Fahr
$\eta = \dfrac{\pi}{2} - \phi + \alpha$
λ = See Equation 7
μ = coefficient of friction tan $\beta = \dfrac{F_t + F_c \tan \alpha}{F_c - F_t \tan \alpha}$
ν = dimensionless coefficient having a value much less than 1
ρ_1 = specific weight of AISI 1015, 0.28 lb/cu in.
τ = shear stress on shear plane, lb/sq in.
ϕ = shear angle

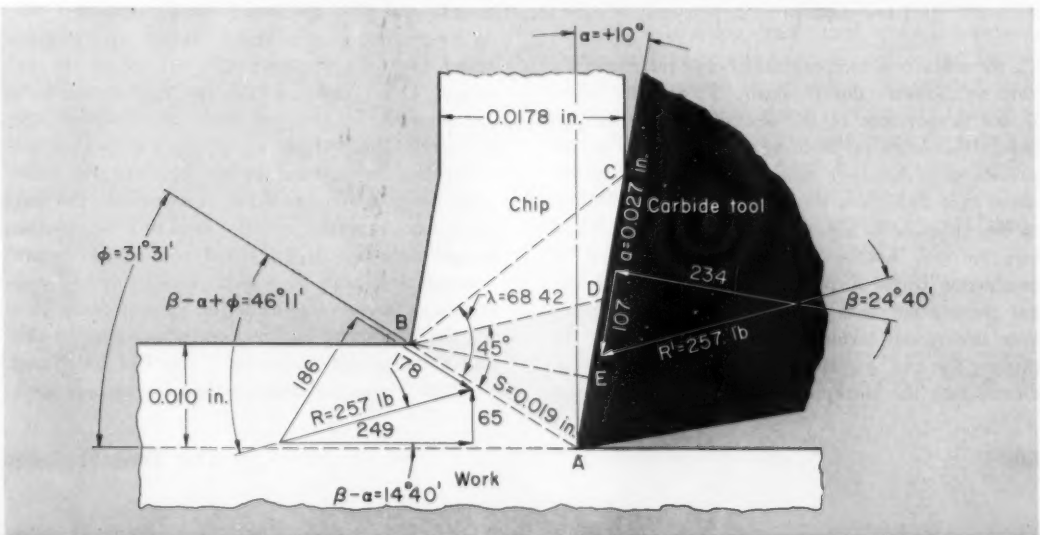
this temperature decreased for both materials. With 10-deg positive rake angle tools, *Figs.* 3*e* and 3*f*, the chip temperature due to shear was considerably lower than with the negative rake tools, practically identical for both materials and increased slightly as cutting speed was increased from 150 to 600 fpm.

Temperature rise due to friction between the chip and tool contact surface increased as the cutting speed increased and was lower for 10-deg negative rake tools than for 10-deg positive rake tools. Temperature rise due to friction was higher for the ceramic than the carbide and was due primarily to the smaller chip-tool contact area on the ceramic and the lower thermal conductivity of the ceramic.

Resultant interface temperature, the sum of the temperatures due to shear and friction, was consistently higher for ceramic tools and helps to explain the difference in appearance of chips formed under otherwise identical conditions.

Distribution of heat between chip and workpiece and between chip and tool has been obtained in the process of calculating temperatures, as all the energy involved in forming the chip appears as sensible

Fig. 5. Geometry and forces affecting carbide cutter with 10-deg positive rake.



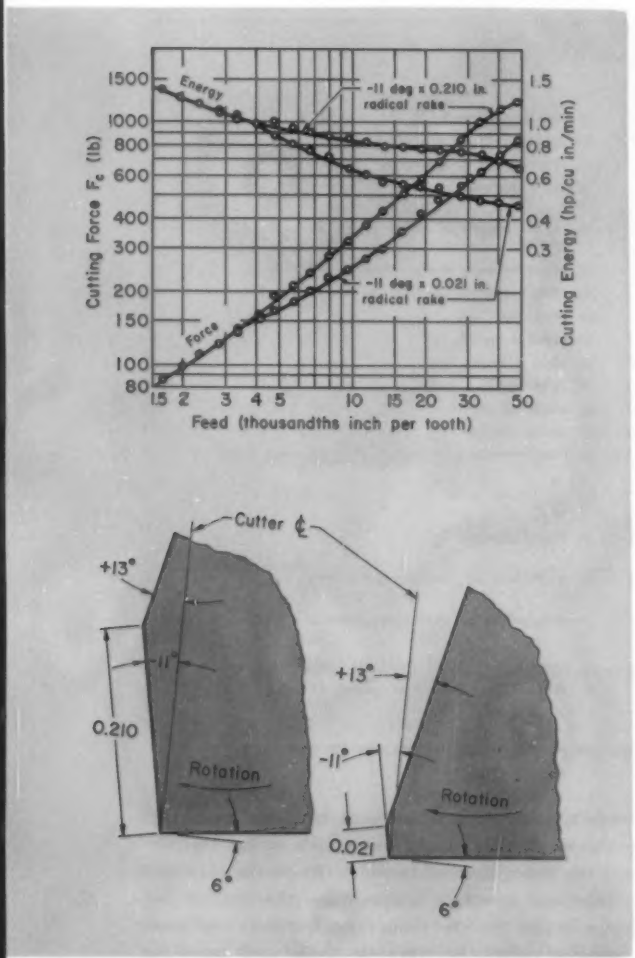


Fig. 6. Tools with a positive rake and a narrow negative rake land require less force and energy. Face milling SAE 1018 with carbide.

heat. The temperature of the chip at the instant of leaving the shear plane is influenced by the various factors expressed in Equation 2.

$$T_s = \frac{\tau\ \gamma}{J c_1 \left(1 + 1.328 \sqrt{\frac{K_1\ \gamma}{V_c\ t_1}}\right)} + T_o \quad \ldots\ldots\ldots (2)$$

T_o, the workpiece temperature always influences T_s, chip temperature due to shear. T_o actually refers to the temperature of the workpiece material just before this material crosses the shear zone in the process of becoming a chip. Heat generated in the shear zone flows into the workpiece by conduction in the direction of relative motion of the tool and into the chip both by material transport and by conduction in the direction of chip flow. Orthogonal planing conducts less heat into the workpiece than orthogonal turning of the end of a tube. In turning the end, a certain portion of the heat conducted into the workpiece during previous passes is still contained in the material about to be removed as a chip. At low cutting speeds, the portion of shear-zone heat conducted to the workpiece is substantially higher than the portion transferred to the chip. The partition of heat is expressed by Equation 3.

$$q_w = (1 - R_1)\ q_s = \frac{\tau\ \gamma}{J}\left(1 - \frac{1}{1 + 1.328 \sqrt{\frac{K_1\ \gamma}{V_c\ t_1}}}\right) \quad \ldots\ldots\ldots (3)$$

At low cutting speeds, shear strain increased, but shear stress varied little with changes in cutting speed and rake angle. Thermal diffusivity for AISI 1015 is strongly temperature dependent, decreasing as the temperature increases. Over-all effect of turning the tube end at low speed is similar to preheating the workpiece. Under such conditions, Equation 4 applies.

$$T_s = \frac{1}{c_1\ \rho_1} R_1\ q_s (1 + \nu) + T_o \quad \ldots\ldots\ldots (4)$$

Since these considerations were not used in the present temperature calculations because of the computation time required, the values of T_s in *Figs. 3e* and *3f* should be increased by as much as 10 percent at the lower cutting speeds.

Lower chip temperatures for the 10-deg positive rake tools are primarily due to the reduced shear strains associated with positive rake tools. Influence of shear stress as a function of rake angle on the variation of chip temperature amounted to about 2 percent on the average.

Average temperature rise due to chip friction at the contact area was computed using Equation 5. Equation 6 also applies.

$$\Delta T_f = \frac{0.377\ a}{k_2 \sqrt{L_2}} R_2\ q_f \quad \ldots\ldots\ldots (5)$$

$$R = \frac{M - (T_s - T_o)}{M + \frac{0.377 a}{k_2 \sqrt{L_2}} q_f} \quad \ldots\ldots\ldots (6)$$

The partition of thermal energy depends on the magnitude of M. Friction force, F_f fluctuated within 10 percent of a common average at any given speed for both ceramic and carbide in the test range. Thus, the value of F_f can be assumed to be the same for either tool material. Similarly, the product $V_c\ r_c$, cutting speed times chip thickness ratio, can be assumed to be the same for either tool material. Under these assumptions, the only difference between carbide and ceramic friction temperature lies in the shape factor and thermal conductivity, both of which contribute to a substantially larger value of M for ceramic tools. Thus R_2, the fraction of friction energy going to the chip and consequently temperature rise due to friction are both higher for ceramic than for carbide tools.

Chip Formation: Angle relationships in metal cutting have been treated in several theories of chip formation. Diagrams of the forces and geometric relations are shown in *Figs.* 4 and 5. The angle λ is generally less for ceramic than for carbide and is less for positive rakes than for negative rakes. It was computed from Equation 7.

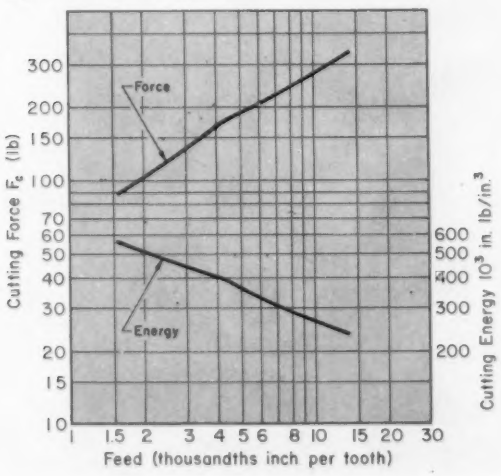
$$\lambda = \tan^{-1} \frac{a \sin \eta}{s\text{-}a \cos \eta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

The resultant cutting force, R, is nearly parallel to the line BD which, according to the solution for the ideal plastic case with no built-up edge, should be the boundary between plastic and rigid regions in the chip and consequently the angle ABD is $\pi/4$. If the stress distribution in the plastic region within triangle ABD is sufficient to determine the force and geometrical relations necessary to form the chip, a question then arises concerning the influence exerted by the remaining portion of the contact length, CD. Since the smear of the chip metal on the tool face extends over the entire contact length, it seems that instead of a sudden transition between plastic and elastic regions in the chip along the line BD, there must be a zone of high elastic strain above the point D. On the other hand, for the built-up edge solution to apply would require the existence at high-cutting speeds of a large built-up edge which is difficult to corroborate in the light of experimental evidence. Occurrence of a built-up edge is closely related to the coefficient of friction at the tool-chip interface and to the physical properties of the chip-tool pair at elevated temperatures. However, since carbide and ceramic tools were similar in chip formation and since no built-up edge could be detected with the ceramic tool even at low-cutting speeds, it cannot be presumed that a sizable built-up edge existed in these tests.

Friction force acting on the tool face in the region AD, computed from the shear stress distribution on the shear plane according to the solution for a perfectly plastic solid, is less than the average friction force over the entire contact length AC. The consequence of this difference is a nonuniform stress field on the tool face. A solution for the plastic region can be constructed having a curved shear zone to accommodate observed relations.

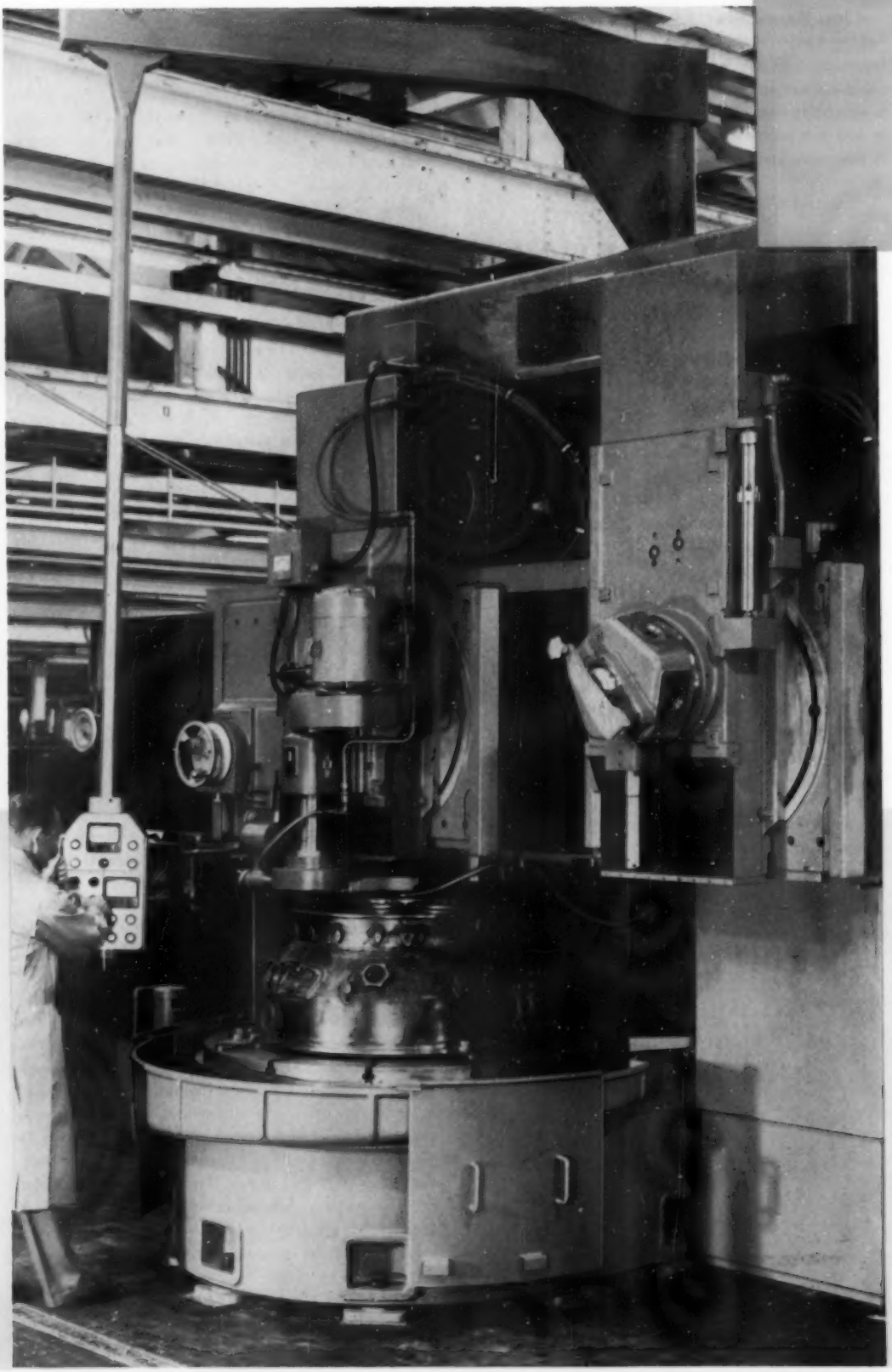
It is probable that a large part of the influence of the remainder of contact length, CD, can be eliminated by removing this region by providing a more positive secondary rake angle on the tool face above point D or thereabout. Earlier tests reveal that reductions in cutting force are accomplished by this procedure. A tool with a positive rake and a narrow negative rake land at the cutting edge has proven itself in shop application in the form of carbide milling cutters as well as single-point tools. Force and energy data for such tools are shown in *Fig.* 6 along with tool configuration. The narrow land required less force and energy than the broad land above the 0.0035 ipt feed. Above the 0.035 ipt point, energy required by the 0.210-inch rake land lessened appreciably. Feeds exceeding $\frac{1}{6}$ the width of primary-radial-rake land reduce force, energy and power consumption compared to a straight negative-radial-rake design. A land of 0.021 inch usually gives good tool life at feeds up to about 0.013 ipt. The 0.210-inch land acts similar to a straight negative-radial-rake at normal milling speeds—that would seldom exceed 0.020 ipt. *Fig.* 7 shows cutting force milling SAE 1018 steel with a ceramic cutter. Comparing it with *Fig.* 6 shows that ceramic and carbide develop similar cutting forces in milling.

Fig. 7. Milling SAE 1018 steel with ceramic. Note similarity of cutting forces to those developed in milling with carbide, *Fig.* 6.



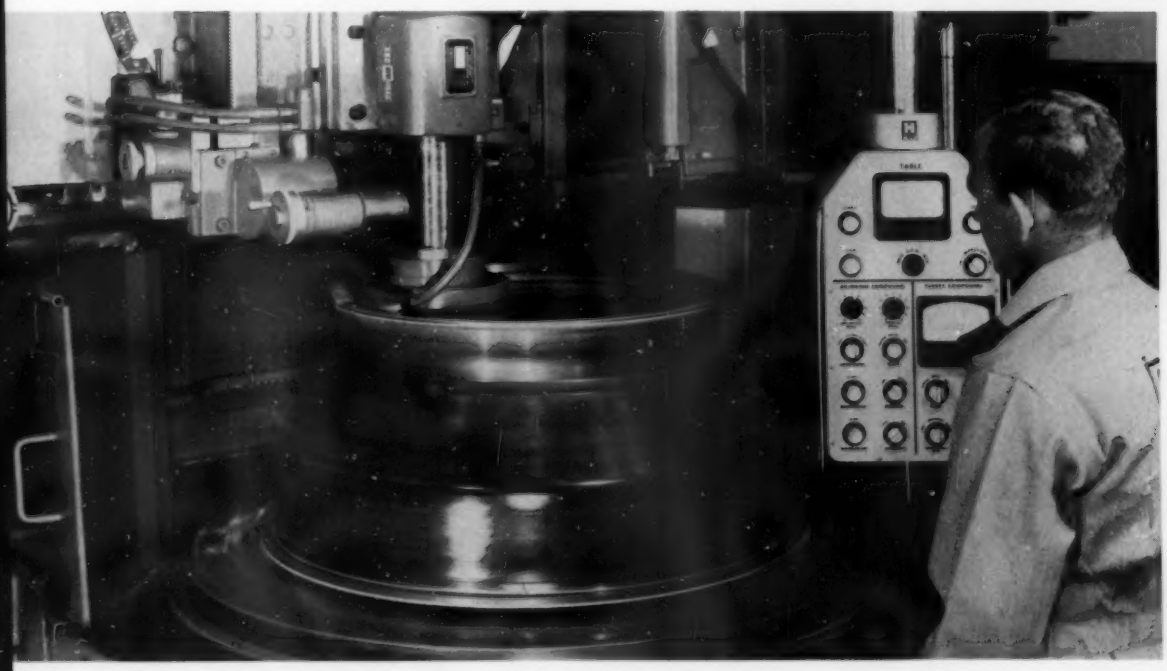
Conclusions: These data on ceramic tool life, although limited in scope, are of value in application to production. Under the same cutting conditions, ceramic and carbide tools exhibit similar characteristics, and are influenced similarly by variations in cutting speed, feed and rake angle. The more blunt or negative rake angles and lower cutting speeds cause larger values of cutting force, specific energy, shear strain and cutting temperatures. As rake angle is changed from negative to positive, increased interface temperatures result. Ceramics perform better than carbides at higher cutting speeds. Smaller contact area and lower thermal conductivity cause higher interface temperatures for the ceramic than for carbide.

Those readers who wish to learn more about the subject of this article can obtain a full bibliography by writing the Editor of THE TOOL ENGINEER.



TOOLS at work

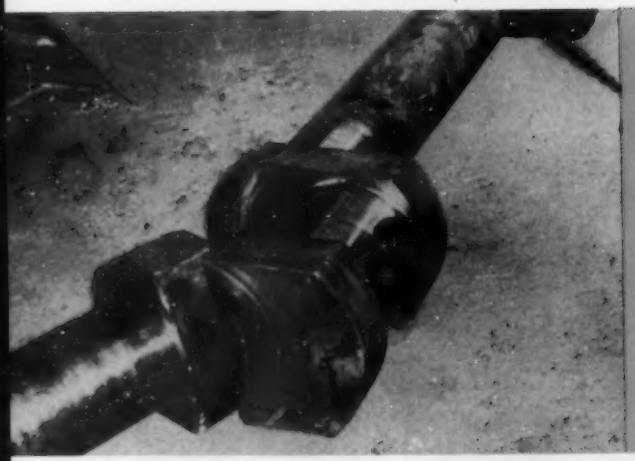
REMANUFACTURING jet engine components after engine teardown can require turning, boring, facing, grinding and other operations before the engine is returned to service. At United Airlines' maintenance base in San Francisco, engines are stripped, components cleaned in solvent and inspected. Chrome plating levels worn or pitted areas. Finish grinding (opposite page and below) at speeds up to 6000 fpm restores the part to dimension within 0.0003 inch and 15-microinch finishes. The turret cutting compound (right) is used primarily for roughing and holds five single-point tools for boring, facing and turning. Both slides have 20-inch travel and swivel 45 deg either side of vertical. Speeds and feeds on the Heald vertical machine are infinitely variable and can be remotely controlled from a pendant while the machine is operating.



TOOLS at work

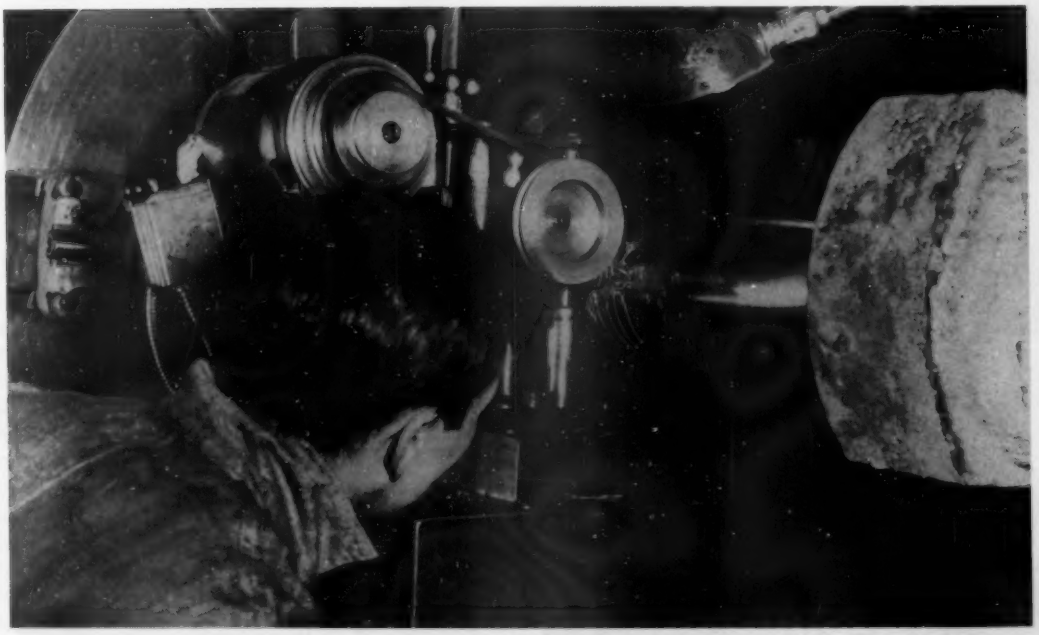
FIBERGLASS threads are wound on a cone-shaped mandrel to produce nose radomes at Lockheed Aircraft Corp. Spinning on a controlled-speed base, the tool pulls the strands through a resin bath and winds 18 layers of 0.015-inch threads onto the cone. After curing, the inside and outside surfaces of the radomes are ground to exact dimensions. Process replaces laborious hand cutting and fitting operations.

INSPECTING machined sections along several axes in one setup is done in reduced time at Convair-San Diego by using closed circuit TV. The camera moves in two axes over the piece and its position is indicated within 0.001-inch by verniers. Cross hairs on the 30X telephoto lens are sighted at a point and its vernier position noted. Moving to the opposite side of the part, the quality control engineer makes a second reading to determine the distance between the two points. A KIN TEL television monitor displays camera position over the part.

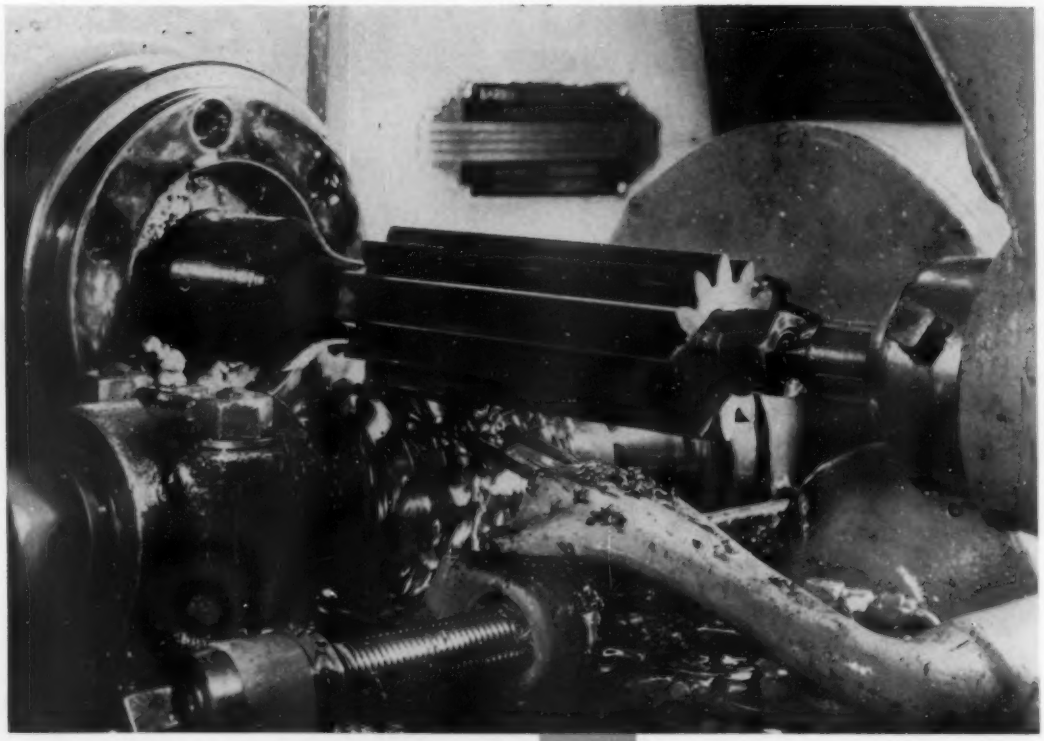


WELDING and machining techniques enable economical repair of broken industrial crankshafts. When received at Industrial Welding & Brazing Inc., this 8-inch diam, 12-ft crankshaft was broken in one cheek and cracked in three other cheeks.

MATCHING FACES of the broken portions are torch cut, leaving four points that serve to guide assembly. The pieces are lined up, tack welded together, and the cut-out portions filled with high-strength weldment. The tacks are then removed and also replaced by high-strength weldment. Bearing surfaces are built up for remachining and the shaft is annealed.



WELD-FILLED keyways are machined true with the shaft using a Dumore Versa-Mil after the shaft has been straightened in the lathe and other surfaces machined to assure accurate alignment. Counterbalances welded to the cheeks enable higher rotational and machining speeds. All operations are completed without removing shaft from lathe.



TOOLS at work

HOBBING of workpieces such as this pump drive gear has been improved at the Iron Fireman Mfg. Co. by a change in cutting oil. A main drive gear for a stoker was selected for test. Eight pieces of UMA-3 forging steel are stacked on an arbor and machined on a Barber-Colman gear hobber at 0.0412 ipr feed and 139 rpm speed. Without changing machining conditions, sulfurized cutting oil was tried and as a result, tool life was increased to 30 pieces per tool grind from the 8 per grind obtained previously. Inspection (left) reveals improvement in finish along with the increase in tool life. The oil, Gulfcut 21C, contains active sulfur for antiweld and pressure properties.

processing

—the forms used
—how to do it

By Harry E. Zimmer
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Curtiss-Wright Corp.
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Manufacturing efficiency depends on the skill and knowledge of the engineers who plan production lines. Based on *Fundamentals of Operation Sheet Writing and Tolerance Chart Building*, the authors show how parts are processed, with emphasis on the use of tolerance charts, operations sheets and other forms. The result is an excellent short course in processing.

PROCESSING—planning how manufacturing operations are to be performed and in what sequence—is sometimes called "machining with a pencil." Alternative production methods are studied and optimum methods are chosen. Practical experience, analytical ability, and creativity are required.

Tool and manufacturing engineers who are responsible for this phase of manufacturing planning have developed a series of forms to aid them in this work—tolerance charts, operation sequence charts, diameter charts and others. These forms and their use are discussed in this article. While the forms shown may not be completely applicable to the operations in all plants, the general approach to manufacturing planning described has an almost universal application. The steps in processing are:

1. The job is analyzed. In the course of this analysis, rough layouts—the first concept of how the part can be processed—are developed.
2. Tolerance charts are developed. These show fixed linear dimensions, tolerances and stock removal. They also serve to check final process dimensions against blueprint dimensions.
3. Routing or operation sequence sheets are written, describing each operation briefly and indicating the equipment on which the operation is to be performed.
4. Diameter charts are drawn for recording dimensions and the amount of stock removal on various diameters.
5. Special process sheets are prepared, usually covering nonmachining specifications such as heat treatment, painting and so on.
6. Operation sheets are made describing each operation. These are for the use of the operator on the production floor.

Manufacturing Processing

To explain the development of a manufacturing process, a relatively simple part, the seal shown in *Fig.* 1 is taken as an example. It has been estimated that planning the processes for this part might take 16 to 24 engineering man-hours. In discussing it

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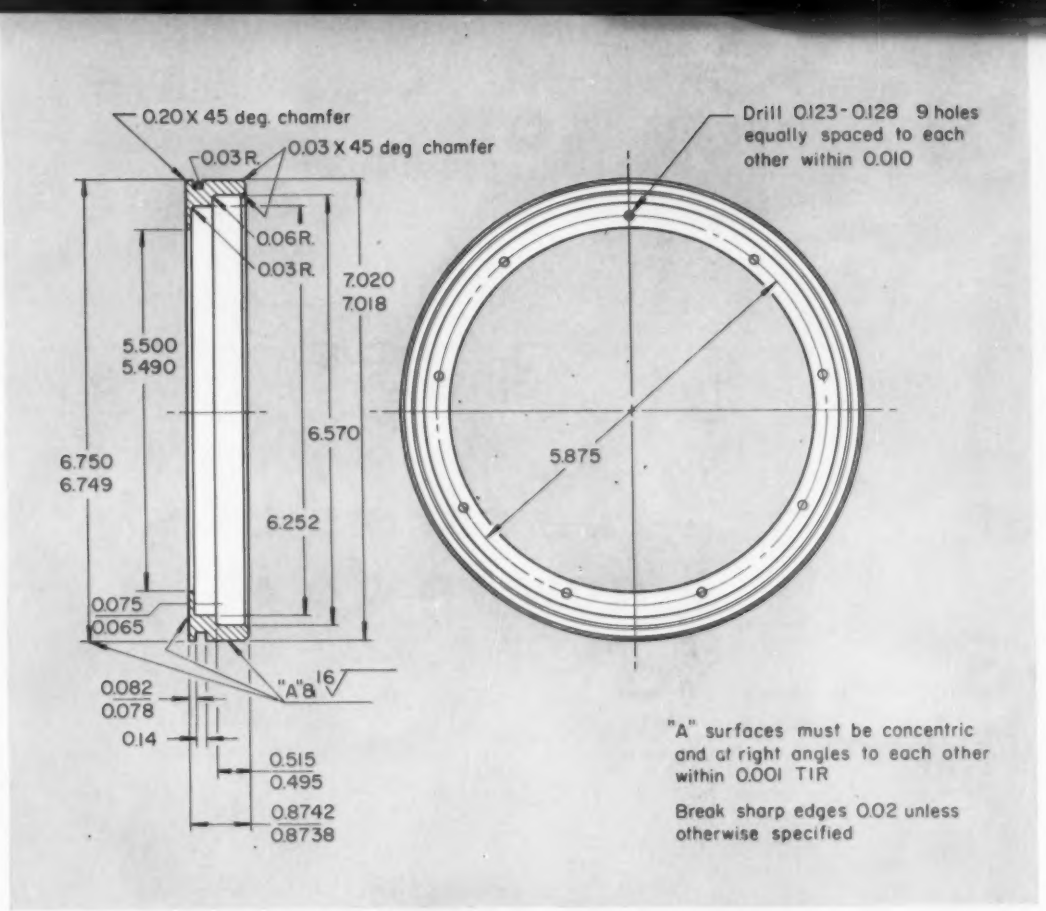


Fig. 1. For this part, the complete manufacturing process is developed.

here, not all detail can be given, nor can all the work of the engineer be adequately indicated. The steps in planning follow.

Rough Layout: In a rough layout, it is important primarily to show clearly the surfaces that are being machined and the surfaces on which the part is being held or located. Referring to the form, *Fig.* 2, the headings serve to indicate the preliminary sequence, equipment and tooling. The larger box, upper left-hand corner, will later contain the correct operation number. Flagged arrows indicate surfaces intended to locate or position the part while it is being machined. Heavy lines on these rough sketches indicate surfaces being "hit" at an operation. Specific sizes or notes are not required at this point unless the processor wishes to call attention (his own or a detailer's) to anything that might be critical. For example, "Block ID" was entered on Sketch 9 because it was felt that the face of the thin wall might not be sufficient to hold it on the magnetic chuck of a Blanchard Surface Grinder.

When it becomes apparent that by oversight an operation has been omitted, such as the drilling of the 0.125-inch holes, this ninth operation is inserted and numbered 8b. Sketch 8 is renumbered 8a, as was done in *Fig.* 2. Similarly, layout sketches may be deleted or changed as the concept of the overall process changes and develops.

Tolerance Chart: With the rough layout satisfactorily completed, work is begun on the tolerance chart. The cross section of the part has been drawn in, as shown in *Fig.* 3. The outline and size of the forging, and other pertinent data are added and the heavy vertical lines are extended downward from the sketch. At the time it is received, the tolerance chart lacks the other entries shown in *Fig.* 3.

Referring to the rough layout, *Fig.* 2, all sketches from 1 to 11 concern machining except 3, 4 and 8b. Only the sketches concerning machining become entries on the tolerance chart. Pertinent facts from Sketch 1 are entered on Line 3 of the tolerance chart. In the "Machine" column, W&S is entered, then the sketch number. The locating surface is entered using the L and dot, according to the legend printed at the bottom of the form. The surface being machined is indicated by an arrow.

Data from the other sketches on the rough layout are entered, omitting Sketches 3, 4 and 8b. A few lines are skipped at the bottom to allow space

in case changes occur, then the blueprint dimensions are entered in the last few lines, in the column headed "B/P Dimension." Heavy horizontal lines are now laid in connecting the dots and arrows. The chart at this stage presents a fair picture of the over-all process, locating surfaces, machined surfaces, equipment used and dimensioning of the various operations.

Stock removal is now entered in the appropriate column, starting at the bottom with finish operations and working toward the top where the first roughing operations are entered. The logic of this method is evident—the amount of stock to be removed by roughing operations is largely determined by the amount removed in finishing operations. To begin, Sketch 11 indicates the operation to be finish grinding the outside groove, two sides and two diameters with a 16-rms finish. The groove is dimensioned tightly with reference to the flange face. Grinding 0.010 inch should clean the faces. The 0.010-inch mean is entered on Lines 22 and 23, followed by a ± sign but no tolerance. The tolerances will be entered after more development of the process shown later in *Figs.* 4, 5 and 6.

Sketches 9 and 10 indicate that the faces must satisfy a squareness requirement of 0.0005 inch. They will have been ground previously, so a stock removal of 0.008 inch is entered as a mean. The first operation on the groove is shown in Sketch 8a, so S is entered for solid stock removal on Lines 15 and 16. Continuing, the other entries are made except the roughing operations shown in Sketches 1 and 2. Amount of stock to be removed in these operations can now be calculated.

Over-all forging width	1.125
Stock removed from end faces by operations of Sketches 5, 6, 9, 10	0.046
	1.079
Over-all blueprint dimension	0.874
Stock to be removed	0.205

This amount is divided between the roughing operations of Sketches 1 and 2, to remove an approximately equal amount from each face.

Machining dimensions can be calculated once the stock removal has been completed. As previously, the entries start at the bottom and work upward. Machining dimensions for Lines 23, 22 and 20 can be copied directly from the finished blueprint dimensions as none of these faces is touched by any subsequent operations. On Line 18, however, the over-all machining dimension must be calculated.

Final blueprint size (Line 24)	0.874
Stock removal (Line 20)	0.008
Total over-all machining dimension	0.882

Whether to add or subtract stock removal amounts in calculating machining dimensions depends on whether the resulting dimension will be greater or smaller, and requires careful attention. For example, machining an ID increases the dimension, machining an OD reduces the dimension. A mixed dimension, such as depth of counterbore (Line 26) will become smaller or larger depending on whether the stock is removed from the outer end face or from the bottom of the counterbore. On Line 16, for example, total stock removal of 0.020 inch (Lines 22 and 23) is subtracted from the blueprint dimension 0.140 inch (Line 28) to find the machining dimension (0.120 inch) for Line 16.

The remaining mean machining dimensions are found in a similar fashion, though the analysis is sometimes more complex. The mean machining dimension of Line 6, for instance, is found as Line 24 minus Line 25 plus the stock removal of Lines 20 and 10, minus stock removal of Line 12.

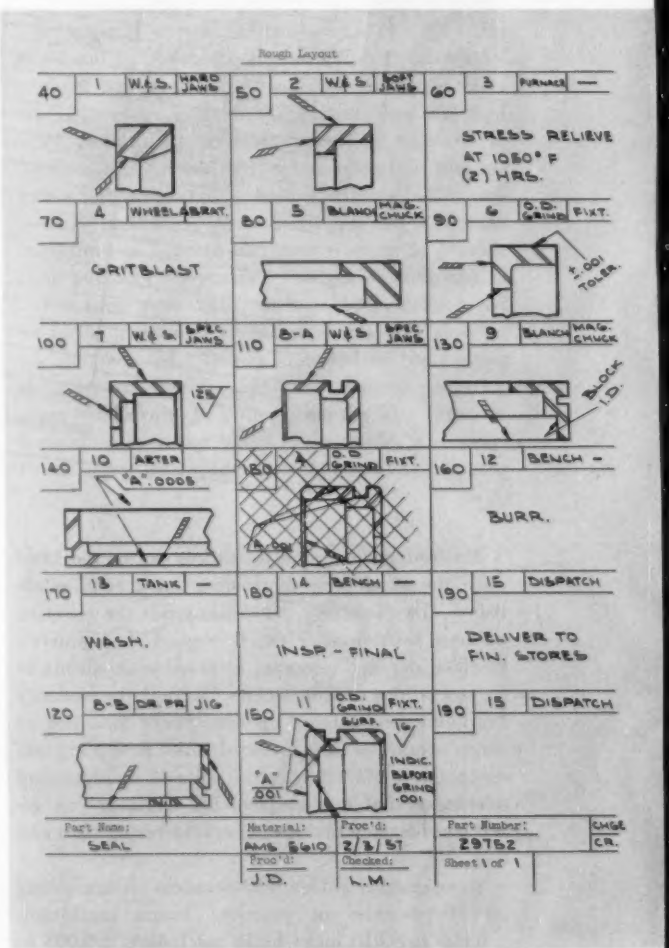


Fig. 2. First step in the process is preparing a rough layout for a process.

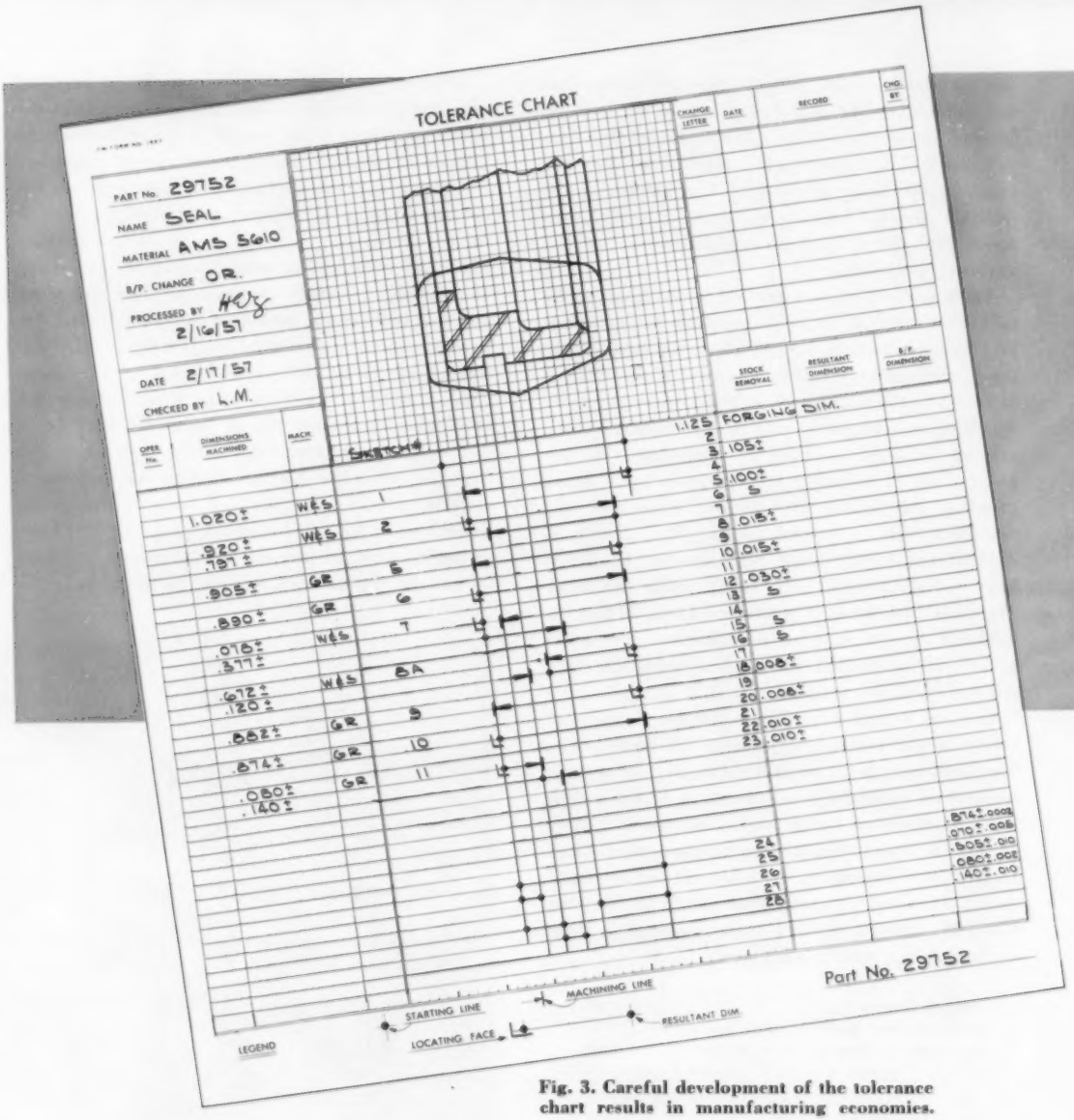


Fig. 3. Careful development of the tolerance chart results in manufacturing economies.

Machining dimension tolerances can be indicated once the machining dimensions have been established. Two contrary principles guide the selection of these tolerances. First, it is good shop practice to allow as much tolerance as possible on all machining operations to reduce costs. Second, the tendency for tolerances to build up when more than two or three operations are involved risks producing unacceptable parts. It is in this area of manipulating tolerances that a manufacturing engineer can effect considerable savings in manufacturing time and cost.

Some general guides for tolerances on machining operations exist in practice: rough machining ±0.005 to 0.010 inch; finish machining ±0.003 to 0.005 inch; green grind ±0.001 to 0.003 inch; finish grind ±0.0001 to 0.002 inch. Using these guides, the tolerances are entered as shown in *Fig.* 4. The tolerances are indicated as wide as possible with the realization that it may be necessary to pull them in to conform to blueprint limits or to avoid a buildup of excessive tolerances.

Resultant dimensions are a means of checking whether the tentatively established tolerances are suitable. Three of the dimensions, Lines 24, 27 and 28, are simply copying jobs. The width of the flange, Line 25 and depth of the counterbore, Line 26 must be worked out to be entered as in *Fig.* 5.

For the flange, the chart shows that it is machined on Line 12 and the outer face is hit on Line 18. Line 12 dimension (0.078 ± .005) less 0.008 stock removal shown on Line 18 gives a resultant dimension of 0.070 ± .005, presumably adequate. But the removal of 0.008 inch of stock is measured from the

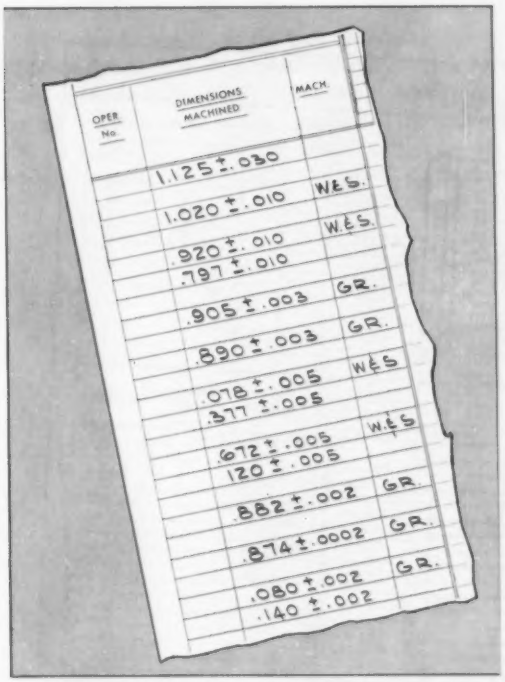


Fig. 4. On the tolerance chart, limits are assigned to the dimensions machined.

face established on Line 10, which must be taken into account in the buildup of tolerances.

0.890 ± .003 (Line 10) less 0.078 ± .005 (Line 12) is 0.812 ± .008

Subtracting this from the over-all dimension 0.882 ± .002 (Line 18), the resultant dimension 0.070 ± .010 for the flange thickness is obtained. Upon entering this on Line 25 it is noted that a tolerance accumulation has occurred exceeding blueprint specifications as shown in *Fig.* 5.

Tolerances are accordingly changed on Lines 10, 12 and 18 to read respectively 0.002, 0.002 and 0.001, totaling 0.005 for Line 25. This closing up of tolerances should not impose serious machining problems.

The depth of the larger counterbore is computed in a similar fashion from data on Lines 10, 13 and 18 to obtain the figure entered on Line 26. When all the resultant dimensions have been computed and found to be within blue-print specifications, the machining dimension tolerances are checked out. Where needed, tolerances are tightened up to meet specifications. Sometimes (Lines 23 and 28) estimated tolerances can be loosened. The entries are shown in their original form in *Figs.* 3, 4 and 5, and in final form in *Fig.* 6.

Limits on stock removal can be established after the machining dimensions and limits have been checked out. In some cases this is simply a matter of subtraction—subtracting the dimension on Line 3 from that on Line 1 gives the entry for stock removal on Line 3. Stock removal limits for Line 5 are also easily computed (the Line 5 dimension is subtracted from the Line 3 dimension).

Other stock removal entries are more involved, as for Line 22. Working from the entries in the dimension column, the sum of Lines 15 and 16 is subtracted from Line 18, obtaining 0.090 ± .011. From this Line 22 is subtracted to find the stock removal limit shown on Line 22 of *Fig.* 6.

Whether simple or complex, stock removal entries are calculated and the complete tolerance chart appears as shown in *Fig.* 6. The operation numbers are actually entered after the routing sheets have been worked out, but are shown here for completeness. The last phase of work on the tolerance chart is to recompute and check every dimension as a precautionary measure.

Routing Sheet: As shown in *Fig.* 7, the routing sheet covers the entire history of a part from the raw material to the finished part. The tolerance chart and layout sheets have established the framework of the process and the routing sheet finalizes the process by assigning operation numbers and brief descriptions to every operation required to produce the finished part. Any operation that requires physical handling by one or more individuals must be entered. The numbering of the individual operations is done in increments of ten to provide open numbers for possible changes or additions.

For some operations, such as wash, deliver and so forth, individual operation sheets with sketches are not required. This is indicated on the routing sheet by an asterisk, signifying that no operation sheet will have to be pulled from the file. When an individual operation sheet is not made, it is sometimes necessary to add instructions to the routing

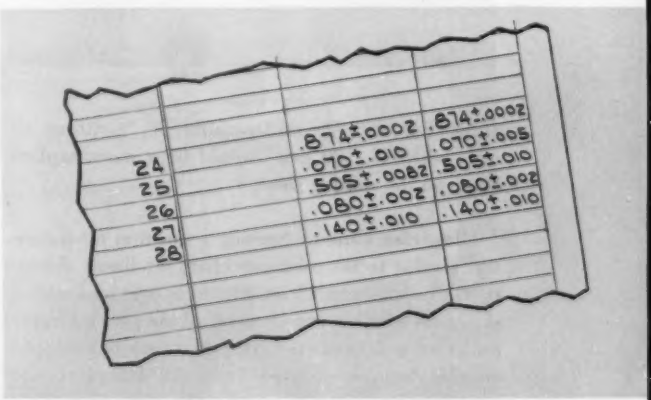


Fig. 5. Tolerance chart accuracy is checked by computing the resultant dimensions and reveals a discrepancy to be corrected on Line 25.

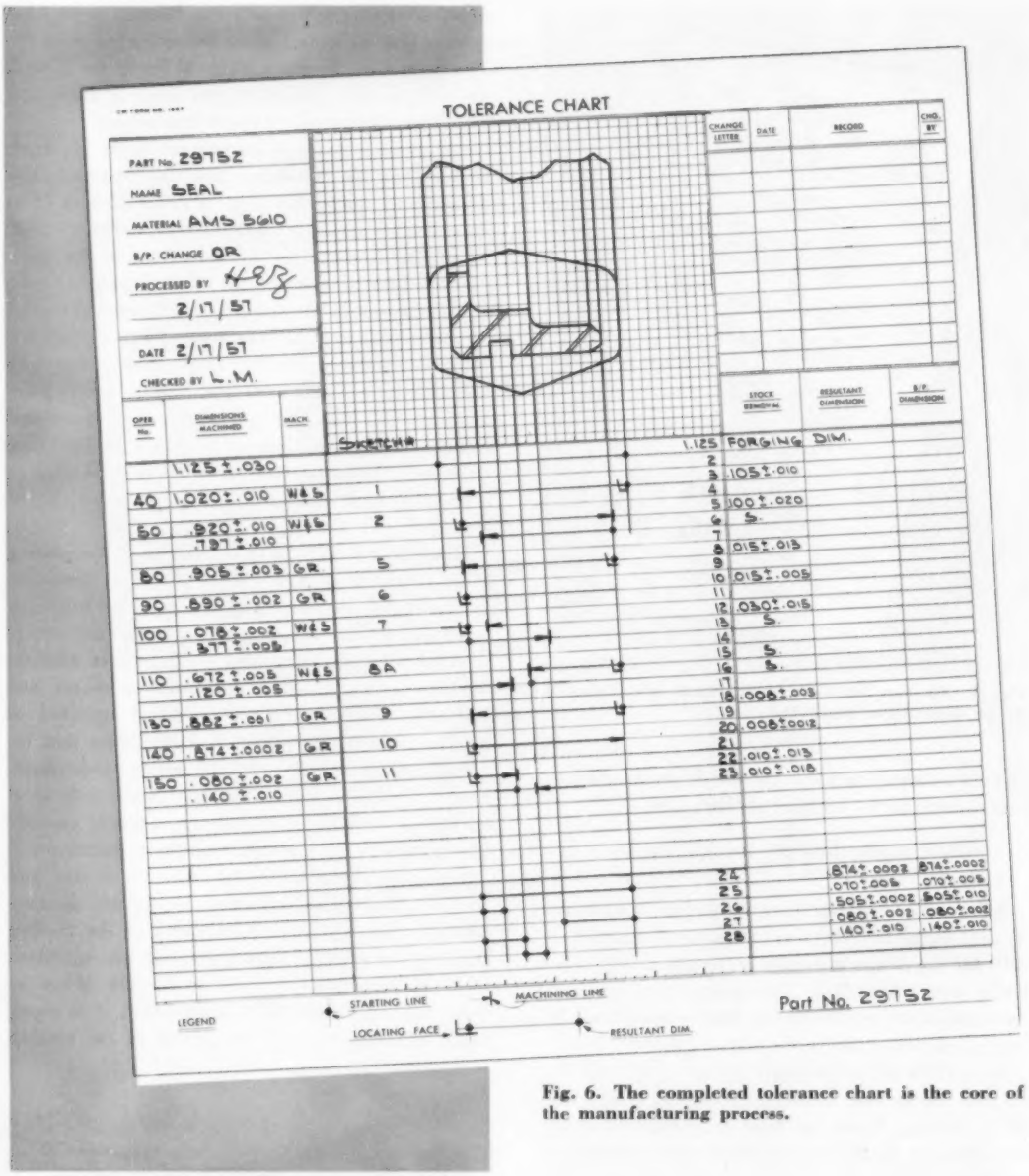


Fig. 6. The completed tolerance chart is the core of the manufacturing process.

sheet. For example, on Operation 70, "Gritblast all over with No. 120 grit" would be a more explicit entry on the routing sheet.

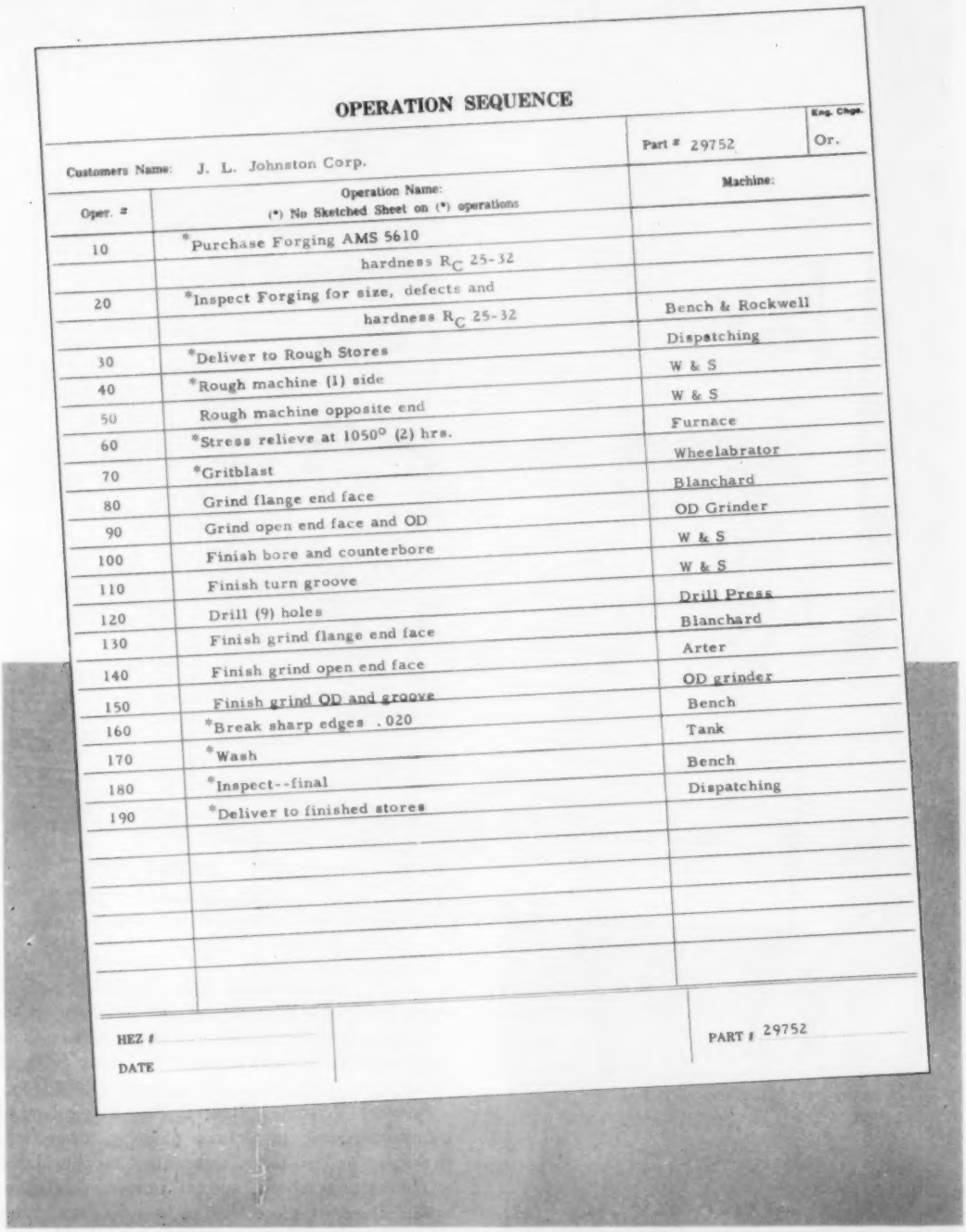
Diameter Chart: Serving a function for diameters similar to the tolerance chart for linear dimensions, the diameter chart, *Fig.* 8, is provided with a sketch on which every diameter of the part is clearly indicated and numbered. The information developed on this form is derived from the blueprint and rough layout.

Starting from the rough layout, Operation 40 hits the OD (Diameter 1 on the diameter chart sketch), so this is entered in Box 1 as 40 L, the L signifying lathe. Next on the rough layout is Operation 50 that hits two ID's and so is entered in Boxes 12 and 13. No dimensions are entered at this time. Continuing, information is transferred from the rough layout to the diameter chart until all operations for all diameters have been listed.

From the blueprint, dimensional information is entered for the last machining concerning any diameter. For instance, the third line of Box 1 is completed to read "150 G 7.019 ± .001." Data are entered appropriately for each of the diameters, each time using the blueprint dimension for entering

the final machining dimension.

With the dimension of the last machining operation established, it is a relatively simple task to work upward on the form, establishing dimensions for the semifinish and rough operations. Operation 150 on Diameter 1 should be given 0.010 inch of stock to remove; accordingly, the preceding operation must leave the diameter 0.020 inches greater than when Operation 150 finishes it. The dimension to which Operation 90 grinds is thus 7.039 inches. Whether stock removal adds to or subtracts from a dimension depends on whether the dimension is an inside or outside diameter, as was noted in calculating dimensions for the tolerance chart. Toler-



OPERATION SEQUENCE

Customers Name: J. L. Johnston Corp. | Part # 29752 | Eng. Chgs. Or.

Oper. #	Operation Name: (*) No Sketched Sheet on (*) operations	Machine:
10	*Purchase Forging AMS 5610 hardness R_C 25-32	
20	*Inspect Forging for size, defects and hardness R_C 25-32	Bench & Rockwell
30	*Deliver to Rough Stores	Dispatching
40	*Rough machine (1) side	W & S
50	Rough machine opposite end	W & S
60	*Stress relieve at 1050° (2) hrs.	Furnace
70	*Gritblast	Wheelabrator
80	Grind flange end face	Blanchard
90	Grind open end face and OD	OD Grinder
100	Finish bore and counterbore	W & S
110	Finish turn groove	W & S
120	Drill (9) holes	Drill Press
130	Finish grind flange end face	Blanchard
140	Finish grind open end face	Arter
150	Finish grind OD and groove	OD grinder
160	*Break sharp edges .020	Bench
170	*Wash	Tank
180	*Inspect--final	Bench
190	*Deliver to finished stores	Dispatching

HEZ #

DATE

PART # 29752

Fig. 7. Every step required to transform raw material into a finished part is listed on the routing sheet.

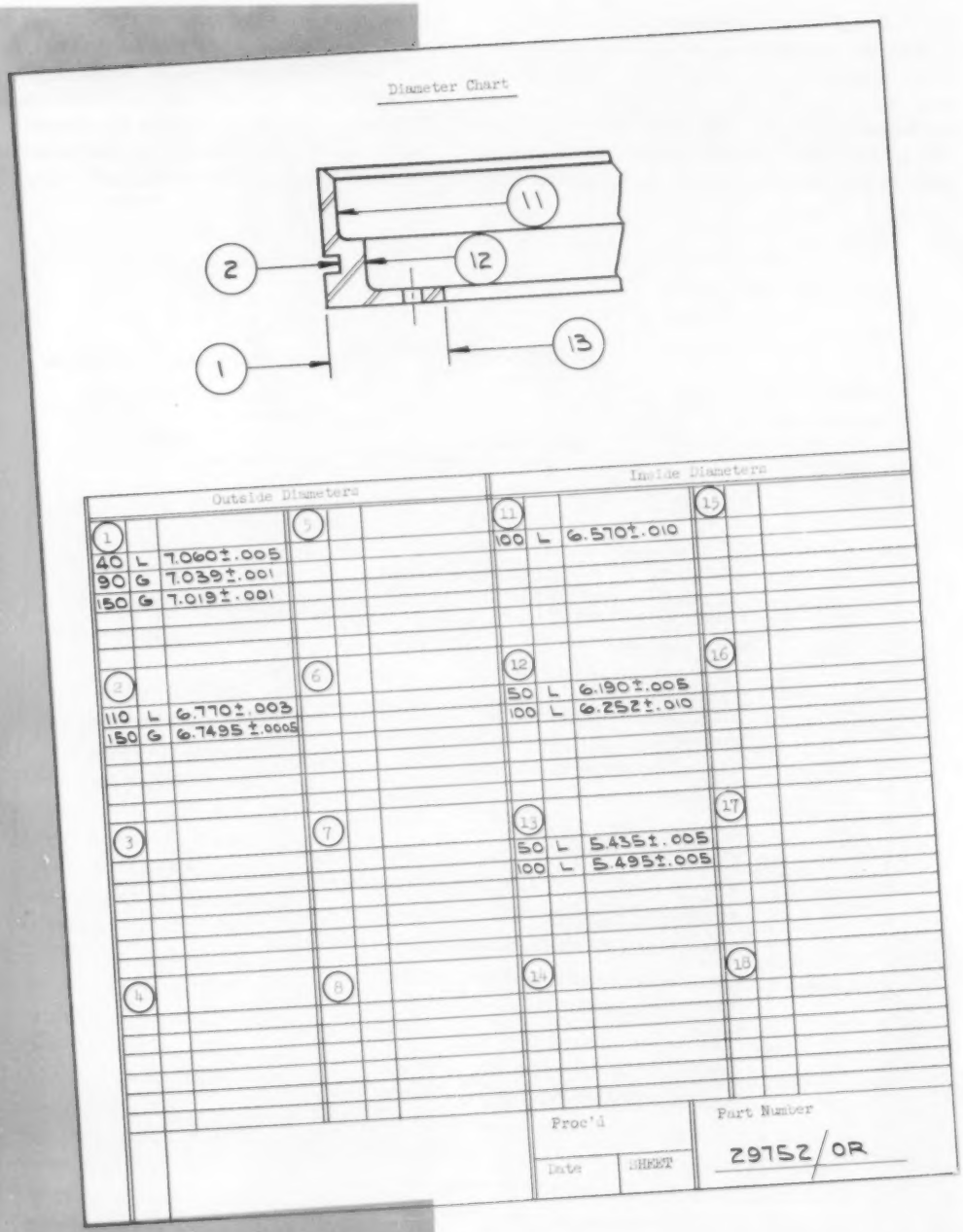


Fig. 8. All diameters of the part are listed on the diameter chart and treated similar to linear dimensions on the tolerance chart.

ances assigned to the various operations are set according to individual judgment, trying to keep them open to avoid excessive costs in machining.

Special Process Sheets: For a number of operations, such as plating, painting, inspecting, packaging and so forth, that cannot be considered machining operations, special process sheets are made. These are often filled in by specialists. With the tolerance chart, routing sheet and diameter

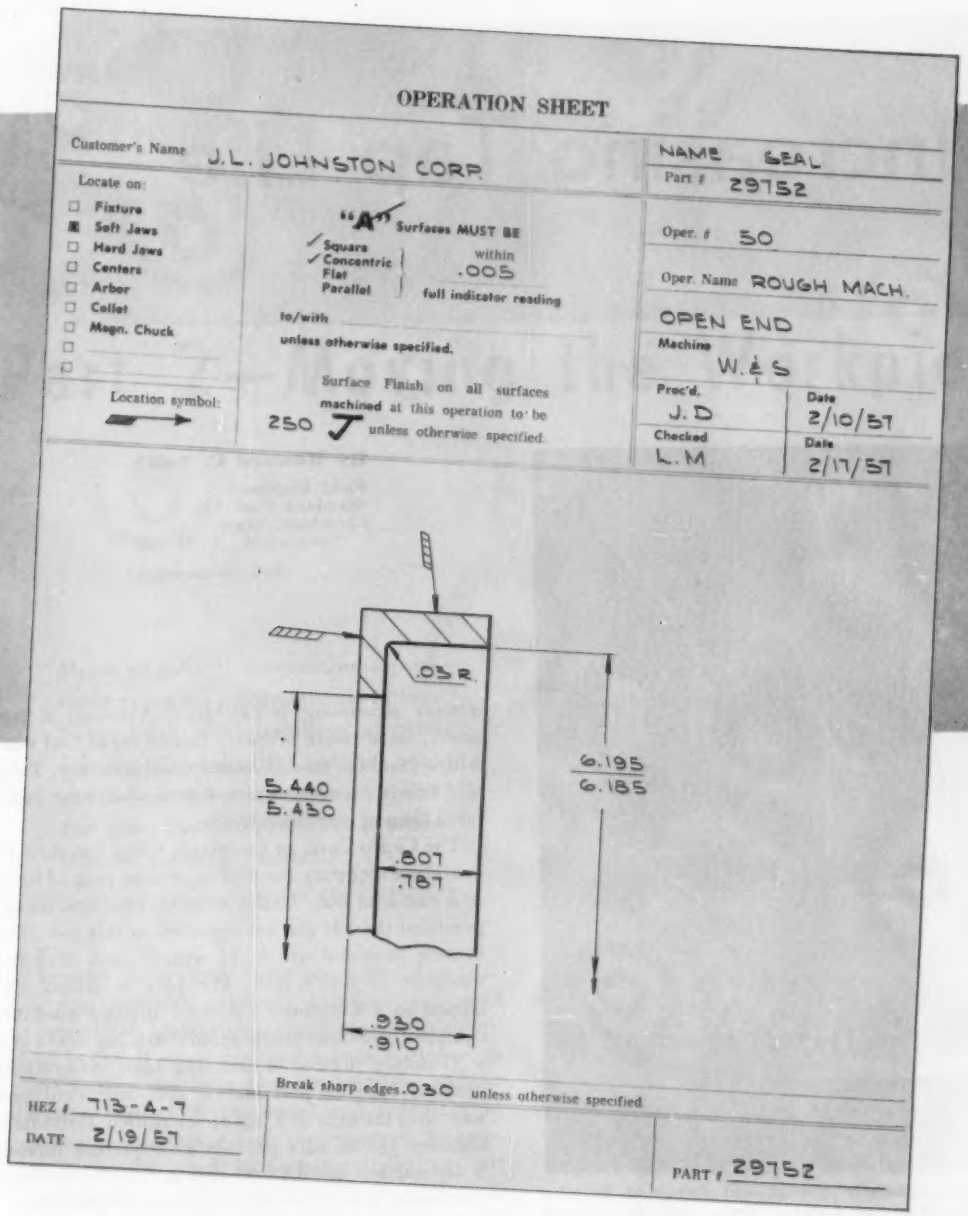


Fig. 9. The manufacturing process culminates in simple and clear instructions for the individual operations.

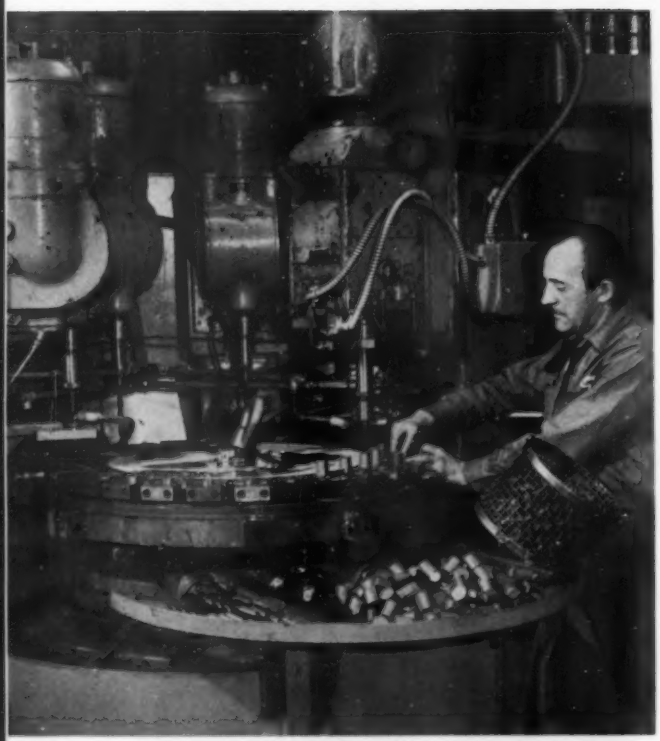
chart worked out, no difficulty should be encountered in dovetailing the special processes into the over-all process. No special process sheets were required.

Operation Sheets: As the finishing phase of the process, instruction sheets are prepared for the individual operations. The long and complex chain of reasoning required to process the entire part culminates in this set of clear, simple and precise operation sheets. Sheets are made for each of the nonasterisked operations listed on the routing sheet. An example, the sheet for Operation 50, is shown in *Fig.* 9. The sketch derives from the rough layout, the diameter dimensions from the diameter chart and the linear dimensions from the tolerance chart.

By means of a handful of such operation sheets, the tool and manufacturing engineer can produce more quickly, accurately and economically with semiskilled operators than skilled machinists can. By his analysis and creativity the process is organized. By his efforts, quality is improved, costs decreased, and productivity increased.

Increasing Tap Life

By Howard C. Noll*
Field Engineer
Standard Tool Co.
Cleveland, Ohio



Parts are manually loaded and unloaded from a 27-station indexing fixture. Three drilling and one tapping operation are performed.

NORMALLY, when attempts are made to obtain better tool life in tapping operations, tool-life limits are sharply defined by the degree of precision required in finished parts. This is because cutting edges must hold up sufficiently to produce in-tolerance parts. To do this, taps must be highly wear resistant if their full potential is to be realized before they wear undersize. In tapping operations, one of the materials offering greatest difficulty from a wear standpoint is cast iron. Although it taps easily, its abrasive property causes rapid tool wear with a resulting loss of dimensional accuracy. Thus, tool life in taps is more a function of wear resistance than of cutting-edge life.

The Capco Corp. of Cleveland, Ohio, has such an operation requiring the drilling and tapping of holes in a cast-iron nut. Unlike most tapping operations, precision threads are not required on this job. The threads produced are $\frac{5}{8}$-11 with a pitch diameter tolerance of 0.010 inch. The part is drilled and tapped on a Kingsbury automatic drilling machine, equipped with four single-spindle drilling heads and a 27-station horizontal indexing table. Operations performed on the part include spot drill, drill part way, drill through and tap. Holes drilled 35/64-inch diameter in the nuts provide a 60 percent thread. A tap surface speed of 60 fpm is used on the cast iron which has a maximum hardness of 200 Bhn.

In production, drill life proved satisfactory with an average of 10,000 parts per sharpening. Tap life, however, was unsatisfactory, averaging less than 400 pieces per tap.

Because tolerances were comparatively large, production of this part presented an ideal opportunity to experiment with taps. In an effort to improve tool life, a long-length tap with flutes designed specifically for cast iron. Rake angles of cutting edges were made radial and wear-resistance ability of the taps was increased by a nitriding process.

Use of the taps has enabled Capco to produce 5000 to 8000 pieces per tap grind, a production increase of approximately 20 to 1. It is also possible to regrind the taps three to four times.

*Senior member ASTME Cleveland chapter.

how to apply
PNEUMATIC POWER
Part 2—Moving the Workpiece

By H. L. Stewart*
Logansport, Ind.

Much of today's automation equipment relies on pneumatic actuation. Some basic work-handling circuits are described by the author, who shows how these circuits are applied for safe, fast and reliable production in modern plants.

MODERN PRODUCTION LINES are, more often than not, equipped with automatic handling equipment of some kind. The major requirement of this equipment is that it move workpieces from operation to operation in as little time as possible without damage. Because of the speed and versatility of pneumatic actuation, a high percentage of the automation devices used in industry today are air powered. These devices can be manually controlled, semiautomatic or fully automatic and, due to the wide range of cylinder sizes available, they are capable of handling extremely small or extremely large workpieces.

A simple electric-pneumatic circuit for moving a workpiece from one point to another is shown in *Fig.* 1. This circuit is suitable for moving workpieces that are not susceptible to damage. For workpieces that are fragile, or for moving containers of parts, the movement must start out and end more smoothly than is possible with this circuit.

In such cases, the use of a cushioned cylinder, or a cylinder with built-in deceleration valves, is advisable. The circuit shown in *Fig.* 2 permits a gradual increase in speed at the beginning of the stroke and a gradual decrease in speed at the end of the stroke. If the cushion nose and cushion collar have a slight taper, the increase and decrease will be more gradual.

Where heavy loads must be moved at high velocities, cushions up to eight inches long are required. The advantage of using cushions is that external cams, cam bars and trips are eliminated. The disadvantages are higher cylinder cost and the greater over-all length of cylinders with long cushions.

The circuit shown in *Fig.* 3 is ideal when smooth, even movement is required. The circuit employs air-oil tanks that impart the smooth action of hydraulic circuits to pneumatic systems. Capacity of the air-oil tanks should be large so that there is no possibility of air entering the oil portion of the system. The resultant foaming will cause erratic feeds. Foaming can be avoided by providing baffles at the top of the tank to prevent the air stream from striking the surface of the oil directly.

This circuit performs as follows: the operator momentarily depresses pushbutton *A*, which energizes solenoid *CC* of four-way valve *C*. The valve spool shifts and air is directed to tank *G*. Oil under pressure is forced through the ball check section of cam-operated flow control valve *E* and then on to the blind end of cylinder *F*. The piston of cylinder *F* will start to move the load slowly, since the roller of valve *D* is depressed. As the cam gradually allows the roller to extend, the piston accelerates and maximum speed is reached. As the piston nears the end of its stroke, the second cam contacts the roller of valve *D* and speed is gradually reduced until the

*Senior member ASTME South Bend chapter.

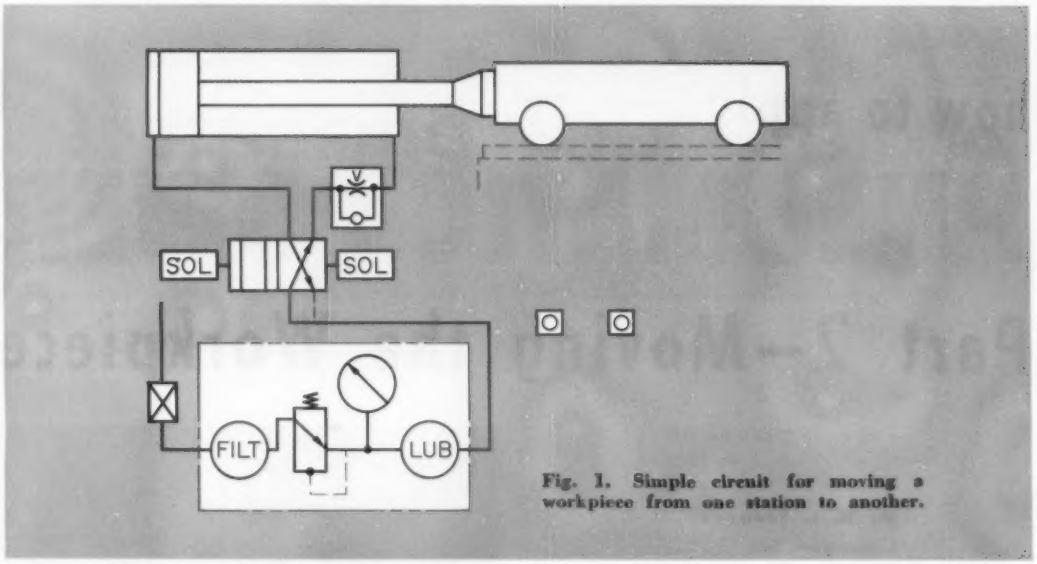


Fig. 1. Simple circuit for moving a workpiece from one station to another.

end of the piston's stroke is reached.

Depending upon the application, the carriage will be retracted in a similar fashion when the operator depresses pushbutton *B*, or the carriage may be uncoupled automatically or manually. The piston of cylinder *F* will retract rapidly if valve *E* is eliminated. This will decrease the time per cycle, yet perform the job required.

The circuit shown in *Fig.* 4 makes use of an air-oil cylinder to perform the same job as the circuit shown in *Fig.* 3. When using this cylinder, it is imperative that all of the air be removed from the oil chamber, otherwise erratic feeds result.

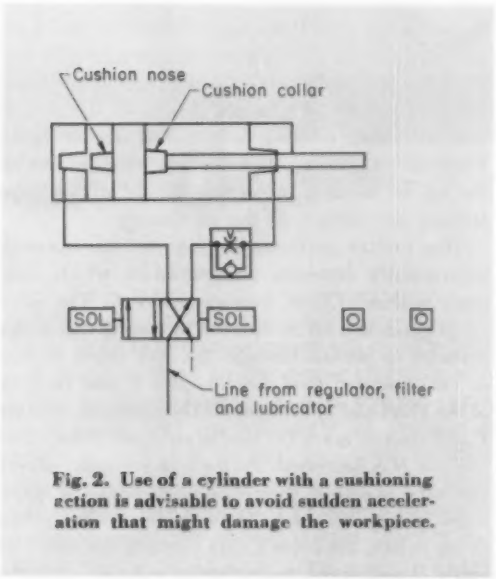


Fig. 2. Use of a cylinder with a cushioning action is advisable to avoid sudden acceleration that might damage the workpiece.

In many production processes, it is necessary to move the workpiece automatically. A basic circuit for this purpose is shown in *Fig.* 5. Here the workpiece moves down a conveyor until it trips limit switch *H*. This energizes solenoid *BB* of valve *B*, shifting the valve spool, and air is directed to the blind end of transfer cylinder *D*. The pusher on the

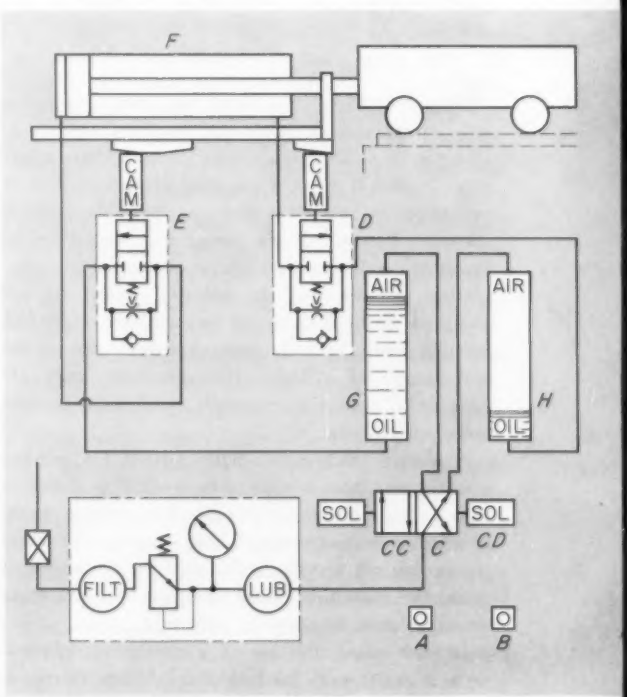


Fig. 3. Use of air-oil tanks imparts a smooth action to the cylinder in this circuit.

piston rod transfers the workpiece onto conveyor *E* at a speed set by flow control *A*. When the piston reaches the end of its stroke, limit switch *G* is contacted, which energizes solenoid *BC*. The valve spool is shifted to its original position, air pressure is directed to the rod end of cylinder *D* and the piston rapidly retracts. The cutoff device mounted on the piston rod will allow only one workpiece to enter the transfer station at a time. If the piston is in the forward position the device will keep the workpiece from entering the transfer station.

If there is possibility of eccentric loading or it is not desirable to have limit switch *G* out in front of the cylinder, the use of a double-end rod cylinder is advisable. This provides the extra bearing support needed when eccentric loads are encountered and also provides a rod in the back end of the cylinder for attaching cams or trips. The diameter of the tail rod, when it is used only to actuate trips, can be smaller than that of the main piston rod. This gives the maximum effective area on the back of the piston.

In highly explosive atmospheres it is often less costly to use pilot controls than to use explosion-proof solenoids, pushbuttons and other electrical equipment. Even on other applications pilot controls are often preferred. Pilot controls are used on the double transfer application shown in *Fig. 6*. Here the workpiece moves into station 1 from a gravity or power conveyor. When the workpiece contacts the roller of three-way pilot valve *B*, pilot line air pressure is directed to pilot chamber *AA* of valve *A* and the valve spool is shifted.

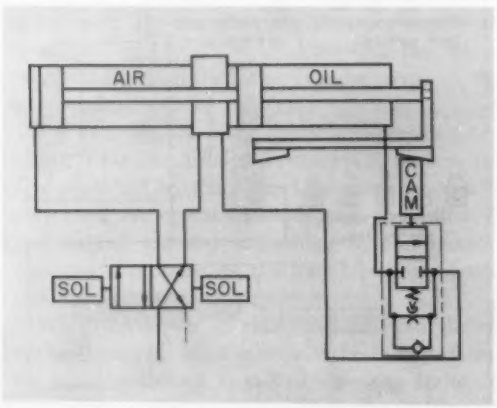
This action causes main-line air pressure to be directed to the blind end of lift cylinder *D* and the piston of this cylinder causes the transfer table to move up to station 2. Air pressure builds up in the line to sequence valve *F*, which is actually a spring-loaded check, and the passage through valve *F* is opened, allowing air to go to the blind end of cylinder *E*. The piston of cylinder *E* moves forward, moving the workpiece from station 2 to station 3. When the roller of three-way pilot valve *C* is depressed, pilot line air pressure is directed to pilot chamber *AB* of valve *A*, shifting the spool, main line air pressure is directed to the rod end of cylinder *E* and the piston retracts. Air pressure builds up, the passage through sequence valve *G* is opened, air flows to the rod end of cylinder *D* and the piston retracts. If a part is ready to move into station 1, another cycle will start.

Often, it is desirable that both pistons retract at approximately the same time so that the cycle can be speeded up. This can be accomplished by eliminating valve *G*. However, it is imperative that the piston of cylinder *E* reach the retracted position just ahead of the piston of cylinder *D* so that four-way valve *A* will not be shifted before the piston of cylinder *E* reaches the retracted position. To accomplish this, a flow-control valve can be placed in the line between the blind end of cylinder *D* and four-way valve *A* so that the restriction will be just enough to allow the piston of cylinder *E* to reach the retracted position first.

If cylinder *D* were to encounter a load prema-

Fig. 4. (below) Circuit using air-hydraulic cylinder performs same job as circuit with air-oil tanks.

Fig. 5. (right) Movement of workpiece initiates cycle of this circuit, giving fully automatic operation.



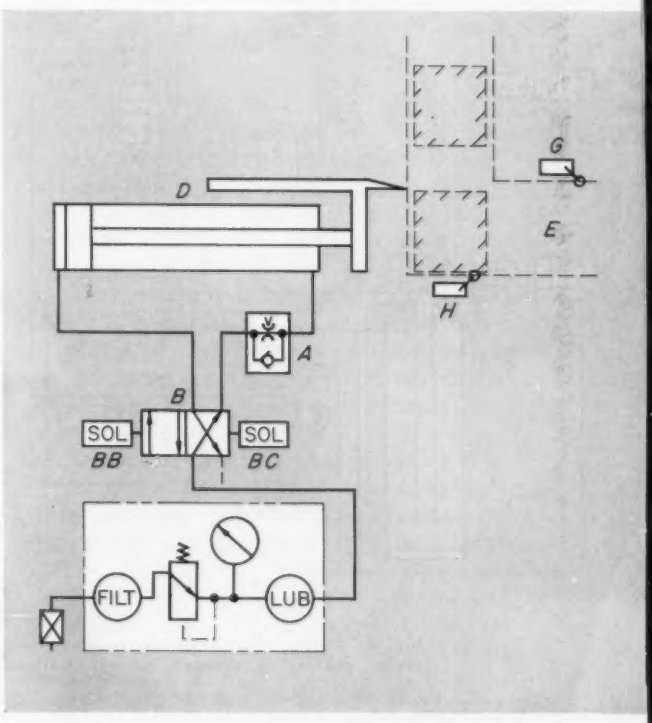


Fig. 6. Circuit for double transfer application. Pilot controls are used here.

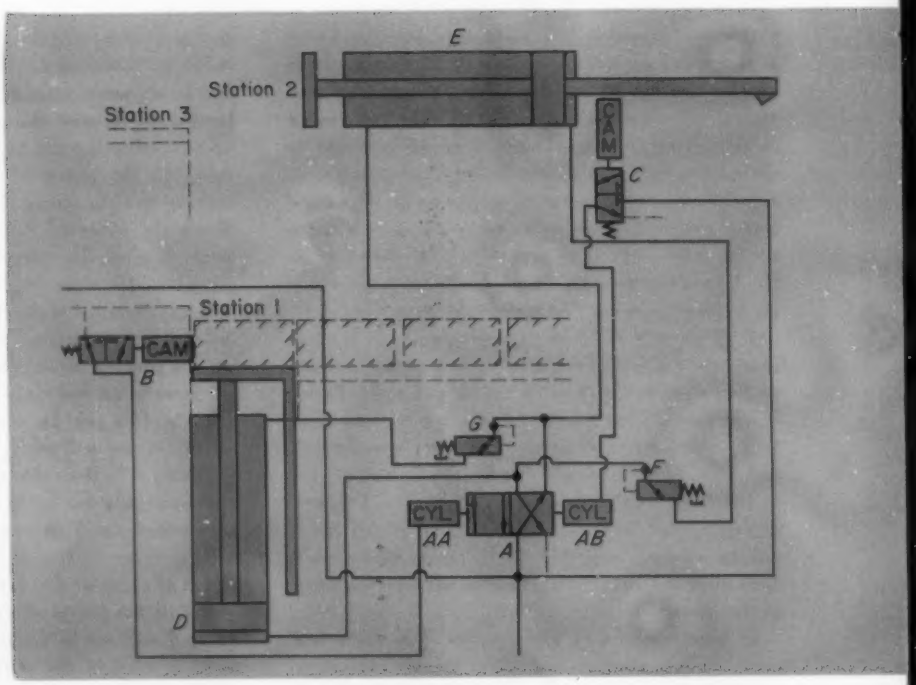
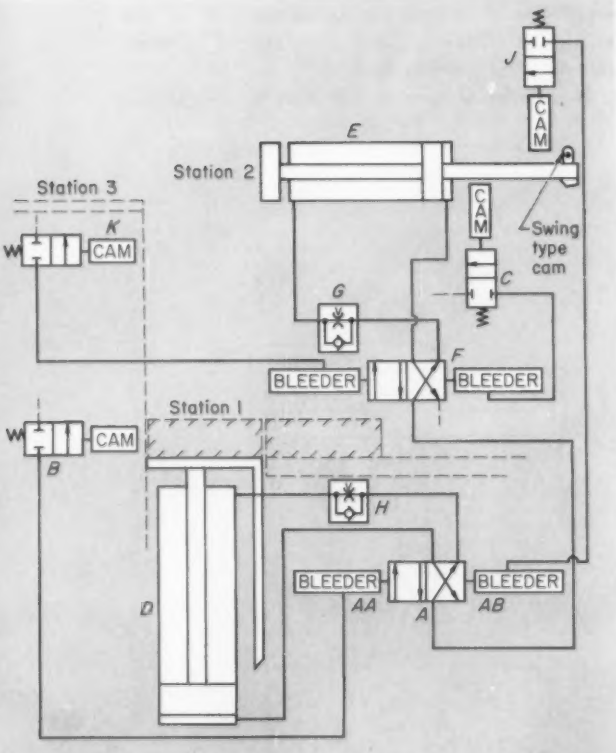


Fig. 7. (below) Variation of circuit shown in *Fig.* 6. Two four-way valves are used so that each valve controls an individual cylinder.



turely—which might be caused by an object becoming caught in the elevating mechanism—trouble would result. The piston of the top transfer cylinder would advance before the vertical cylinder reached station *B*. With the piston rod of cylinder *E* out, the piston of cylinder *D* would finish its travel. The workpiece would slam into the piston rod of cylinder *E*, causing considerable damage.

To overcome such a hazard the circuit shown in *Fig.* 7 can be used. Here every movement is positive. This circuit can be operated by either pilot

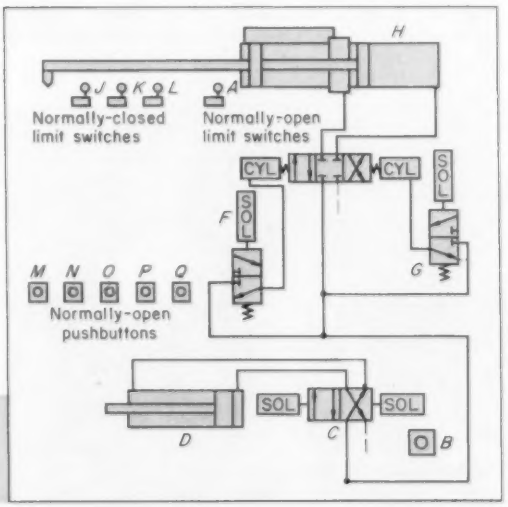


Fig. 8. (right) Circuit for clamping a workpiece, moving it through several stations.

or electrical controls. Pilot controls of the bleeder type are shown. With bleeder-operated pilot controls, less piping is required for the pilot lines but if these lines are too long, the controls will not function properly. This is due to the rapid expansion of compressed air when released.

In the circuit, two four-way valves are used so that each valve controls a cylinder. There are no connecting lines between cylinders. The cycle starts when the workpiece contacts two-way valve *B*, which opens to allow air to bleed from pilot chamber *AA* of valve *A*. The spool of this valve shifts and air is directed to the blind end of cylinder *D*. The speed of the piston is controlled by flow control *H*. By eliminating the sequence valves used in the circuit shown in *Fig.* 6, flow controls can be included without danger of causing malfunction of the circuit.

As the piston of cylinder *D* reaches the end of its stroke, two-way valve *K* is momentarily tripped, causing air to be bled from the pilot chamber of valve *F*. The shifting of the spool causes air to be directed to the blind end of cylinder *E* and the workpiece is moved from station 2 to station 3. As the workpiece approaches station 3, the cam depresses the roller of valve *C*, which causes the spool of valve *F* to return to its original position. Air is directed to the rod end of cylinder *E* and its piston retracts. When the piston approaches the end of its stroke, a swing type cam on the tail rod of cylinder *E* depresses the roller on two-way valve *J*. This causes the spool of valve *A* to shift and air is directed to the rod end of cylinder *D*. Its piston retracts rapidly and it is then ready for the next cycle.

There are applications where it is desirable to clamp the workpiece, move it through several stations, then release it. In the circuit shown in *Fig.* 8 an air-hydraulic cylinder is used to position the workpiece and an air cylinder to clamp it. In this circuit, the operator has the choice of four positions other than the starting position. The operator places the workpiece in the clamping device and momentarily depresses pushbutton *B*, which causes the spool of four-way valve *C* to shift, directing air to the blind end of cylinder *D* and the workpiece is clamped. The operator can then perform work at any of four locations by depressing the appropriate pushbutton until the cylinder stops at the selected limit switch.

For example, when the operator depresses pushbutton *N* the piston rod will retract until limit switch *J* is contacted by the cam. After the operation is performed the operator can depress pushbutton *O* and the rod will stop at position *K*. The operator also can skip some of the buttons, which makes this circuit versatile.

When the piston of cylinder *H* reaches the retracted position, limit switch *A* is contacted and the spool of valve *C* is shifted, directing air to the rod end of cylinder *D* and the workpiece is unclamped. If a quick cutoff of movement is desired, a solenoid shutoff valve can be installed in the closed hydraulic line. This would be a normally-open valve.

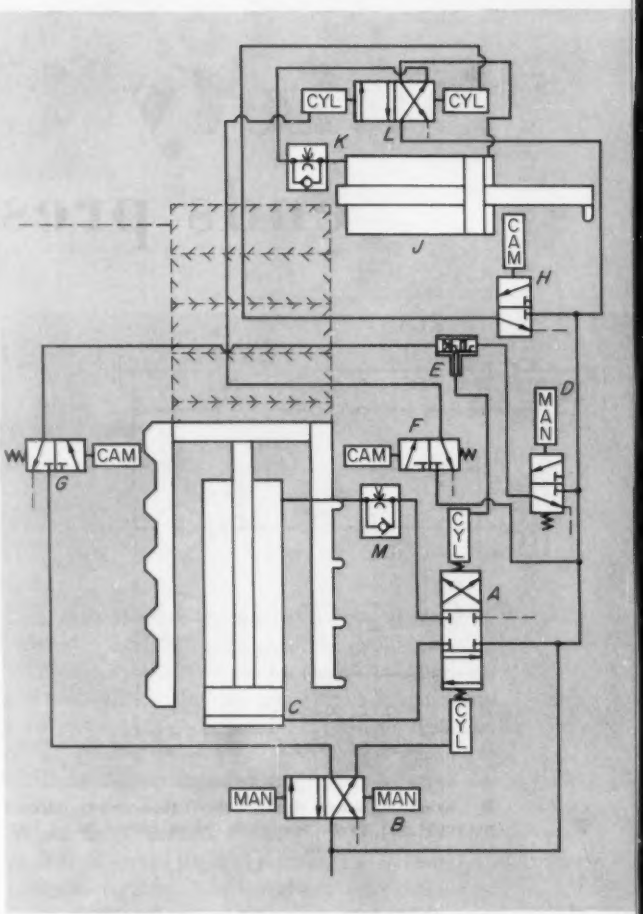


Fig. 9. Circuit shown in *Fig.* 8, modified for automatic operation. Pilot controls are used.

A variation of this circuit is shown in *Fig.* 9. This circuit can be used for stacking applications. While it is started by a manually actuated valve, the addition of another cylinder and controls can make the cycle automatic. In the circuit shown, pilot controls are used. Valve *G*, a normally open three-way type, controls the stops. Valve *E*, a spring offset shuttle valve, keeps air from exhausting when it is required to actuate pilot of valve *A*. Valve *B*, a four-way two-position valve, is used for directing pressure alternately to valve *G* or to the pilot of valve *A*.

Movement of both the workpiece and the tool by pneumatic means will be discussed in the final installment of this article, which will appear in the October issue.

Safety Circuit ends press injuries

By Henry C. Spencer*

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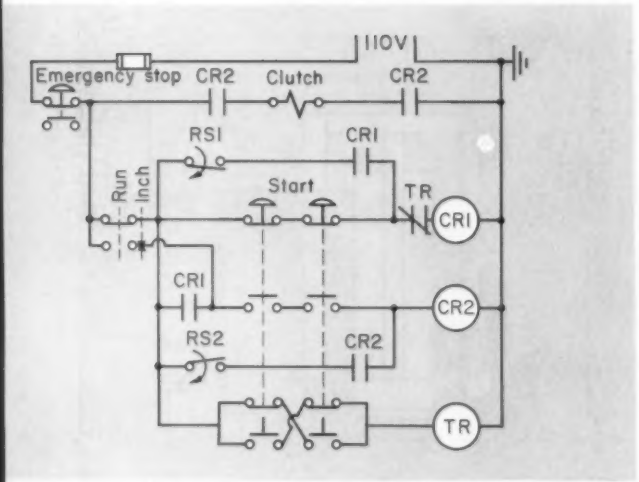
Montreal, Quebec, Canada



By using a timer delay relay, this safety circuit prevents any press operation when either hand button is fastened down.

OPERATOR SAFETY is a paramount consideration in press operation. Guards, harnesses and other devices are used to keep the operator's hands out of the danger area during the working stroke. Where such devices interfere with feeding and operating the press, two-handed controls are used. Operators sometimes disable the two-handed safety control by tying down one of the controls, thereby endangering themselves.

To eliminate the intentional circumvention of safety features two-handed tripping devices are often designed to prevent operation when one of the buttons is fastened down. However, it is possible under certain circumstances to initiate one stroke of operation even though the machine cannot be repeatedly cycled. Obviously, operator injury can occur during the stroke.

More complete protection is obtainable by placing a time delay relay in series with additional contacts on the two hand buttons, as shown in the circuit diagram. When both buttons are depressed, no circuit is made to the timer. When either of the hand buttons is fastened down, the circuit is completed. After a preset period, the timer opens its normally closed contacts, de-energizing relay CR1. Normally open contacts of CR1 in series with relay CR2 drop out, de-energizing CR2. The normally open CR2 contacts in series with the clutch solenoid open, rendering the machine inoperative. The time delay is adjustable, but is usually set at 0.5 second.

This safety control has been applied to power presses having air-actuated clutches as well as to hydraulic presses and special machines where the same kind of protection is desired. The schematic drawing shows the arrangement used to apply the safety feature to a Minster press. Part of the standard equipment of the press is a rotary switch whose contacts, RS1 and RS2 are shown. To operate the press, the two hand buttons must be held down until the ram is near the bottom of its stroke. At this point RS2 closes, maintaining the circuit through the solenoid actuating relay CR2 until the ram approaches top center. Near top center, RS2 opens, de-energizing CR2 and thus the clutch solenoid. RS1 was intended to prevent a second stroke should one of the hand buttons be fastened down, but becomes logically redundant when the timing relay and switch contacts are used.

The safety circuit is applicable to many machines. Whether it is economical depends to some extent on the type of electrical control elements existing on the machine. For presses equipped with mechanical clutches, similar circuits using pneumatic elements can be applied. Or, by actuating the clutch trip rod with a solenoid instead of a foot treadle, the electrical safety circuit can be used. For hydraulic presses, whether ram return is caused by releasing the control buttons or by reversal collars depends on valve and hydraulic circuit design. However, the safety circuit will make certain that the two hand buttons must be simultaneously pressed to bring the ram down, then released and repressed for each subsequent stroke, thus improving safety.

*Senior member ASTME Montreal chapter.

drilling • reaming • tapping titanium

drilling

HOLE DEPTH is important in drill life as it affects chip flow, clogging and point smearing—major factors in titanium drilling. As the drill dulls, chips flow with increasing difficulty and some chips stick to drill lips and margins. They soon become packed and wedged in the flutes and cause the drill to fail, either by overheating or seizing. Good points produce good chips.

Chip formation indicates drill condition. Uniform smooth chips are produced by a sharp drill. Shirred or feathered chips mean the drill has dulled. When chips become discolored and irregular, the tool has failed. This can mean the workpiece has been ruined if the hole is to be tapped subsequently.

In drilling holes over one diameter deep, the drill should be retracted frequently to clear the drill flutes and hole of chips. For deep small diameter holes, sulfochlorinated oils should be supplied freely at the point of contact. Large flutes help prevent clogging. Chrome-plated or oxide-coated drills resist galling and smearing on the drill margin. Data on drilling is given in TABLES 1 to 3.

Table 1—Tool Materials for Drilling Titanium

Type of Operation	Recommended Material
General Drilling	T-4 or T-5 HSS
Deep holes, low production	T-5 HSS
Deep holes, high production	C-1 or C-2 carbide
Sheet, drilling	T-4, T-5, or M-10 HSS

Table 2—Tool Geometry for Drilling Titanium

Type of Operation	Hole Diameter (in.)	Type of Point	Point Angle (deg)	Helix Angle (deg)	Relief Angle (deg)	Cutting Angle (deg)
General and deep-hole drilling (HSS)	⁄ 0.25	spiral	140	28-35	9-10	0
	⁄ 0.25	spiral	90	28-35	9-10	0
Sheet, power drilling (HSS)	⁄ 0.25	spiral	135	15	12-15	0
	⁄ 0.5	spiral	118	15	12-15	0
Sheet, hand drilling (HSS)	⁄ 0.25	spiral	150	15	12-15	0
	⁄ 0.5	spiral	135	15	12-15	0
Deep hole drilling (carbide)	⁄ 0.25	single lip	--	--	6-8	--
	⁄ 0.5	gun drill	--	--	6-8	--

Table 3—Machine Settings for Drilling Titanium

Operation	Titanium Grade	Speed (fpm)	Feed (ipr)
General and deep-hole drilling with HSS	Commercially Pure	40-60	0.0015*
	Annealed Alloy	20-50	0.0015*
	Heat-treat Alloy	5-40	0.0015*
Drilling sheet with HSS	Commercially Pure	15-40	0.002-0.005†
	Annealed Alloy	20-30	0.002-0.005†
	Heat-treat Alloy	10-25	0.002-0.005†
Drilling deep holes with carbide	Commercially Pure	200	0.005
	Annealed Alloy	100-170	0.005
	Heat-treat Alloy	75-45	0.0005

*For holes of 0.125-inch diam or less. Use 0.0002 to 0.005 ipr for holes up to 0.25-inch diam and 0.005 to 0.009 ipr for holes up to 0.5-inch diam.
†Hand drilling titanium requires approximately twice the axial force required for drilling aluminum.

reaming

Reaming titanium is not especially difficult, and can provide holes with a tolerance of +0.002 to -0.000. The tendency for reamer margins to gall and seize can be eliminated by selecting proper tool design and operating conditions. Spiral-fluted reamers are generally preferred for titanium. For normal operation, T-1 or T-5 HSS is recommended. for high-speed production, C-3 or C-4 carbides. Feeds should be increased in proportion to the diameter of the hole. Sulfochlorinated oils are the best cutting fluid. Recommended tool geometry and machine settings are presented in TABLE 4.

Table 4—Tool Geometry and Machine Settings for Reaming Titanium

Geometry and Settings	Carbide Tools	HSS Tools
Clearance angle (deg)	10-15	10-15
Relief angle (deg)	5-10	5-10
Margin or land (in.)	0.010-0.015	0.010-0.015
Speed (fpm)	100-200	20-30
Feed (ipr)	0.005-0.008	0.005-0.008
Depth of cut (in.)	up to 0.030	----

tapping

Tapping is probably the most critical titanium machining operation as titanium tends to seize and gall. An incorrectly tapped hole can mean scrapping an almost completed part. Tapping should not be attempted if the hole shows signs of burning or roughness. The hole should be redrilled or reamed and tapped with shallower threads. All taps used should be precision ground and stress relieved before use. Surface treatments such as black oxide coating or nitriding assist in reducing the tendency of titanium to rub against the tap. Paste type cutting compounds and sulfochlorinated oils are helpful. Oils should be strained frequently to keep small chips from re-entering the hole and fouling the tap. Most of the water-base emulsions are insufficiently active and should not be used.

The most successful taps are those with interrupted threads and alternate teeth removed. Eccentrically grinding the thread crests so that only the first third of the thread contacts the titanium, or grinding a large chamfer in the trailing edges of the tap, reduces rubbing between the tap and work. Spiral-point interrupted flute taps employed at slow speeds yield the best results.

Broken taps can be removed using nitric acid, which attacks steel but not titanium. The hole is first cleaned and then filled with acid and left to stand for a few minutes to an hour until the tap is sufficiently loosened for removal.

The best tool material for tapping titanium is T-1 HSS. A five-thread chamfer is recommended. The following tool angles give good results: spiral point, 10-17 deg; spiral 110 deg; relief, 2-4 deg; cutting rake, 6-10 deg; heel rake, —3 deg. Two-flute taps should be used for size ¼ 20 and smaller; three-flute taps for larger sizes.

Recommended tapping lubricants are lithopone paste (30 percent SAE 20 oil, 70 percent lithopone) and sulfochlorinated oil.

For commercially pure alloys, tapping speeds of 40-50 fpm are recommended. For annealed alloys, speeds of 10-30 fpm should be used. Tapping speeds for heat-treated alloys are 5-20 fpm.

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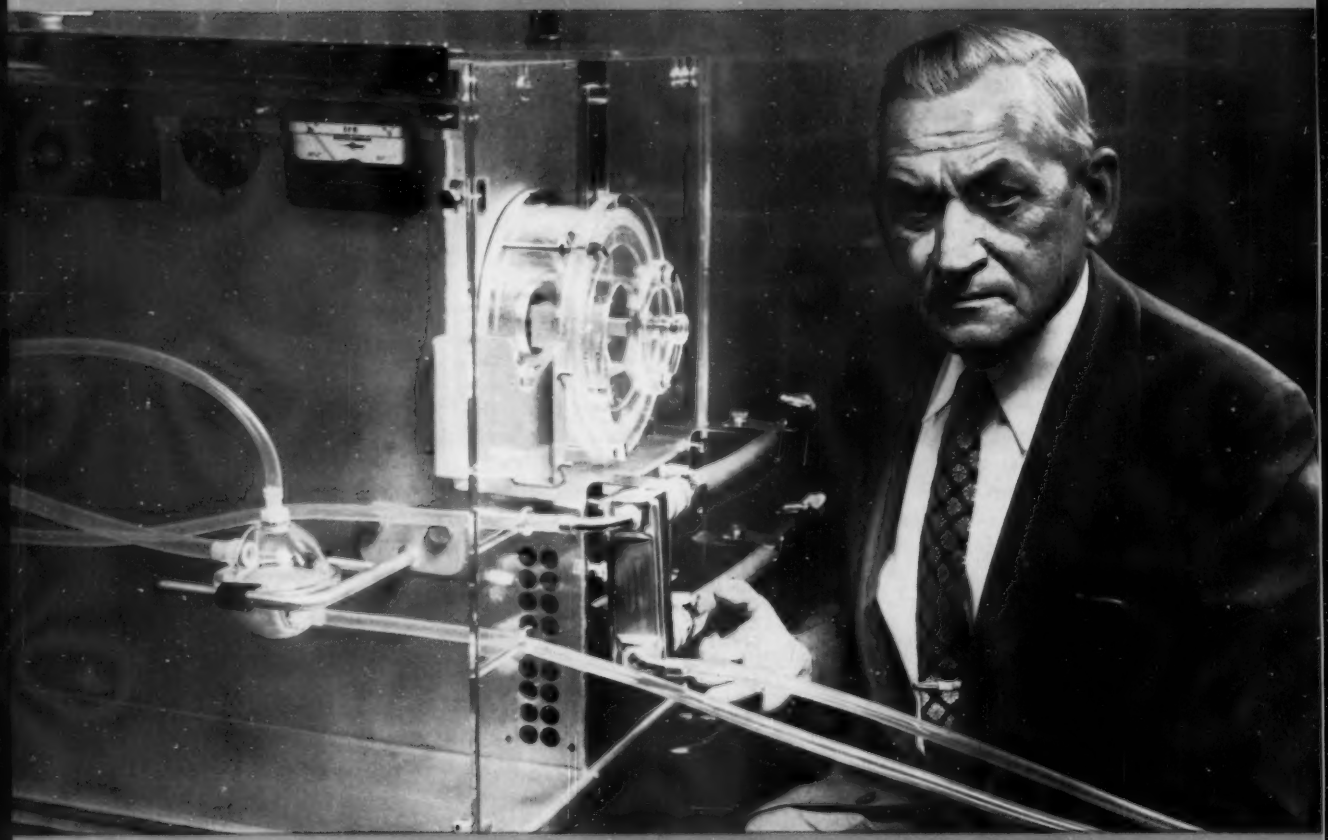

Joseph Chyba, Baltimore chapter member, seen here with his disposable heat exchanger attached to a heart-lung machine. See page 89, "Engineer Cuts Surgical Costs."

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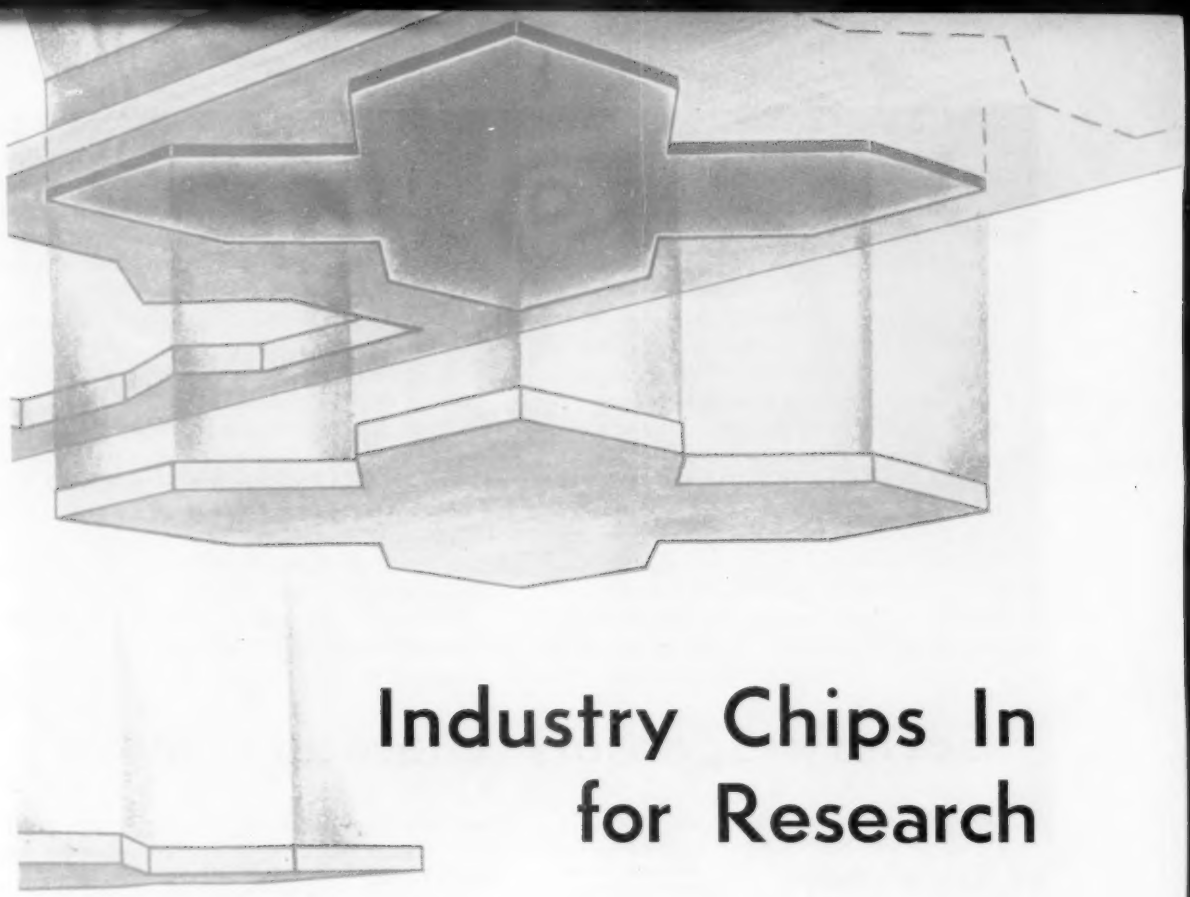


Industry Chips In for Research

WHEN RESEARCH DIRECTOR Leslie S. Fletcher talks about one of his favorite projects around Society Headquarters these days, his voice is apt to take on a note of pride that reaches parade-ground proportions. And well it might—for the retired Army colonel and the Research Fund Committee which he directs have something worth parading about.

After years of passing the Society's research proposals before the reviewing stand of industry brass, Fletcher has finally clicked.

A four-figure check earmarked for support of ASTME's Metal Stamping Research Project, currently being conducted under contract at Syracuse University, has brought the total of industry's cash contributions to $26,770—enough to complete the work.

This marks the first time in the 10-year history of the Research Fund Committee that an ASTME-sponsored project has been 100 percent supported by industry. Other projects have been supported, liberally, but none heretofore have been completed without the Society's reaching deep into its own pocket to underwrite some of the contractual, in addition to administrative, costs.

"Thirty-three companies, big and small, have contributed to the Syracuse punchability project," Col. Fletcher reported. "But I want to emphasize that the money these companies have given is only a part of the total industry benefaction.

"Besides cash, there have been uncounted contributions of talent and ideas, and uncountable contributions of man-hours and moral support.

"Last but not least, there's quite a list of gifts and loans in kind—equipment, test material and testing services. This list includes a punch press, special punches and dies, gages, even five tons of the special electrical steel that the Syracuse research is targeted on.

"The interest and cooperation of industry is a gratifying testimonial of their confidence in ASTME's research program. Theirs is not an investment in 'blue sky' or 'good will'; it is an investment in the one asset none of us can do without—continued progress."

The Syracuse project, which is only the first skirmish in a broad attack on stamping problems, is specifically seeking to justify the development of a punchability rating method for electrical steels.

Now in its last phase, with the final report due within two or three months, the Syracuse research has already given indications of being vitally important to the U.S. economy. The dollar value of the stamping of electrical steels in America is con-

servatively estimated at a million dollars per day, year-round. A hint that the campus researchers have found infinitesimal particles of extreme hardness (of the magnitude of perhaps 100/200 Rockwell C) in the edge of the punched slug may lead, if proved to be fact, to whole new fields, new savings, and new efficiencies.

Knowledge—of what is true and what is not true, and why—is sorely needed on the science of the art of metal stamping. The following companies have recognized this need, by writing checks:

Allegheny-Ludlum Steel Corp.; Allis-Chalmers Mfg. Co.; Armco Steel Corp.; Clearing Machine Corp.; Cleveland Crane & Engrg. Co.; Columbia Tool Steel Co.; Crucible Steel Co. of America; Dayton Perforators, Inc.; Delco Products Div., GMC; Firth Sterling, Inc.; General Electric Co.; Haddon Tool & Mfg. Co.; Harig Mfg. Corp.; Jack & Heintz, Inc.; Jessop Steel Co.; Latrobe Steel Co.; Moore Special Tool Co., Inc.; Niagara Machine & Tool Works; Oberg Mfg. Co., Inc.; Precision Welder & Flexopress Corp.; Producto Machine Co.; Reliance Electric & Engrg. Co.; Texaco, Inc.; Timken Roller Bearing Co.; U.S. Steel Corp.; Urbana Tool & Die Co.; Universal-Cyclops Steel Corp.; Vanadium-Alloys Steel Co.; Van Straaten Chemical Co.; Verson Allsteel Press Co.; Walsh Press Div., American Gage; Westinghouse Electric Corp.; and Wheeling Steel Corp.

At last count, over 60 companies or independent divisions of large companies were represented on the Metal Stamping Project by 84 persons. Chairman of the stamping project committee is S. B. Fuerst, consultant, Manufacturing Engineering Research, General Electric, Schenectady; chairman of the parent 13-member Research Fund Committee is Past President Howard McMillen, manager of manufacturing, Copeland Refrigeration Corp.

The project has already resulted in ASTME Research Reports Nos. 22 through 28.

Society Sponsors Educators' Meet

EVERYTHING'S UP TO DATE in Kansas City, as the song goes, and ASTME members play no modest role in keeping it that way.

They do so by promulgating the latest knowledge and techniques of tool and manufacturing engineering. Through the Society's books, magazine, tool shows, chapter technical meetings, seminars and bull sessions, ASTME has become quite a proficient vehicle for ideas—ideas which are ultimately translated into goods to keep Kansas City up to date.

While the Society has developed a sophisticated procedure for disseminating knowledge to engineers and to industry, it has just recently extended its sphere of influence and sponsored a series of metal-processing sessions to educate the educators.

The National Education Committee of ASTME and the industrial engineering division of the American Society for Engineering Education got together to sponsor a two-day summer school at Purdue University. The conference's aim was to recognize, and perhaps help solve, the problems that industrial engineering professors face in keeping their instructional programs aligned with industry's needs and apace with technological progress.

For, these societies believe, everything must also be up to date in the university engineering schools if the manufacturing industry is going to keep pace with the needs of those up-to-date people in Kansas City—or Kankakee, or Kalamazoo.

34 Major Schools Represented

Under the joint ASEE-ASTME aegis, 61 registrants showed up at Purdue from 34 major universities and colleges across the country, as well as from several industries and one branch of the armed forces.

They heard metal-processing course material presented during two days of lectures, material actually used in the highly rated classrooms and labs of Purdue, University of Illinois, Syracuse University, Massachusetts Institute of Technology, University of Michigan, and Spring Garden Institute in Philadelphia.

This material was gathered by the National Education Committee into a 300-page syllabus of sound approaches to metal-processing instruction. Because of cost, distribution was limited to registrants. The manual is the first such comprehensive collection of metal-processing teaching data ever assembled. In essence, the syllabus aims at providing a teaching method for an up-to-date engineering program; it is a collection of actual exercises, reproduced without changes of any kind and even showing instructors' marginal notes and emendations.

Dale Long, president of Scully-Jones & Co. and of ASTME, was among the speakers. Also presenting industry's views on the kind of graduates they are looking for was a panel composed of Oliver S. Hulley of General Electric, the current NEC chairman; Carl Oxford, Jr., National Twist Drill; H. C. Reel, Westinghouse; and Edward Reed, Chevrolet Div., General Motors.

Serving as general chairman of the sessions was Arthur F. Gould of Lehigh University, last year's chairman of the National Education Committee.

The new and the old in heat exchangers are illustrated here. In the foreground is Joseph Chyba's disposable exchanger which has proved itself much more practical than the old-style—and much more costly—bulky one. Chyba worked in conjunction with doctors at the University of Maryland medical school.

Engineer Cuts Surgical Costs

By **Elizabeth R. Rooney**
Assistant News Editor

"WE KNOW WHAT WE WANT. The problem is to find a precision tool designer who can turn this thing into a reality." Cardio-vascular surgeons and internists at the University of Maryland's medical school found their precision tool designer in Joseph Chyba, a member of the Baltimore ASTME chapter.

Chyba volunteered his time and talent. His task was to modify the design and construct a heat exchanger that could be disposed of after just one use. Because of this, the exchanger had to be inexpensive and lightweight. A number of consultations with the medical men, especially Dr. William G. Esmond of U. of M's department of surgery, gave Chyba a good idea of what the doctors needed and the amount of work that would be involved.

The need for a new type of heat exchanger arose when those men at the university who developed and operate a pump-oxygenator were having trouble maintaining heat balance during the perfusion of patients undergoing surgery for the correction of congenital heart disease. The doctors themselves constructed several exchangers, all of which proved unsatisfactory. One was discarded because of the difficulty in cleaning its interior of stainless-steel tubing. Another exchanger, made of brass and stainless steel which was silver soldered, cracked during steam sterilization and had to be retired from service.

Finally Chyba, who had read of the urgent need for cooperation between doctors and tool engineers in an article about an Ann Arbor medical-engineering forum appearing in THE TOOL ENGINEER in May 1959, volunteered his services.

He immediately began work on a number of precision dies that eventually resulted in a disposable, stainless-steel, blood heat exchanger.

The first units Chyba delivered were tops in performance, according to the doctors. They could transfer slightly greater amounts of heat under identical conditions of flow and temperature than

those exchangers now in use which are constructed of heliarc welded stainless steel and cost hundreds of dollars.

So good was the performance of Chyba's disposable exchanger, it was reported on at a recent meeting of the American Society for Artificial Internal Organs in Chicago. The paper describing the development of the heat exchanger bore a rather formidable title—"Design and Application of a Disposable Stainless-Steel Blood Heat Exchanger with the Integrated Disposable Plastic Disc Oxygenation System." It weighed the pros and cons of those heat exchangers now in existence against Chyba's. The smaller disposable exchanger clearly outshone the others.

Small enough to fit into the palm of the hand, the device contains an inner accordion-pleated cooling surface measuring 0.005 x 4¾ x 26½ inches and can handle a blood flow at a rate of 500 to 6000 cc's per minute. Made of stainless steel, it can be attached to the circuit of a heart-lung machine when it is necessary to cool the blood as it comes from the patient. It was reported in the Chicago paper that Chyba's exchanger achieves excellent heat transfer using water as a medium at a rate of three to six gallons per minute.

Dr. Esmond, whom Chyba worked closely with on the construction of the device and who developed the theory behind it, relates that one of its major advantages is that only 60 cc's of blood is required for priming as opposed to the 175 cc's now needed in bulkier equipment. The use of a reservoir with a bubble trap is also unnecessary. Already clinically evaluated and tested, the exchanger, when it appears commercially, will sell for $20 each in lots of five—quite a difference from the usual $900 paid for units presently in service.

The Baltimore team of Esmond and Chyba isn't the first example of successful cooperation between medical men and engineers. Tool engineer Therlo W. Lawrence of the Ann Arbor ASTME chapter, working with Dr. Clarence E. Crook of the Cardio-Vascular Research Association and St. Joseph Mercy Hospital, developed a combination heat exchanger and bubble trap which was reported in this magazine last February.

Member Heads Medical Fund Group

Walter K. Bailey

FURTHER EVIDENCE of industry's growing interest in medicine is the appointment of a Machine Tool Builders and Machinery Division of the National Fund for Medical Education. A member of Cleveland ASTME chapter, President Walter K. Bailey of Warner & Swasey, is the chairman of the group.

The fund is spearheading a nationwide appeal to raise $10 million annually for the country's 83 accredited medical schools. In accepting the appointment, Bailey declared that his 16-member committee would seek to enlist the support of his industry behind the drive.

Among those serving with Bailey on the committee are Louis F. Polk, president of The Sheffield Corp. and member of the ASTME Research Fund Committee; Henry D. Sharpe, Jr., president of Brown & Sharpe and member of Little Rhody chapter; H. Glenn Bixby, president of Ex-Cell-O Corp.; Alfred B. Bodine, president of The Bodine Corp.; Milton P. Higgins, president of the Norton Co.; Edward C. Bullard, chairman of The Bullard Co.; John J. Prindiville, Jr., president of LaPointe Machine Tool Co.; and other leaders in the industry.

Bailey pointed up the need to help medical education remain self-sufficient. He said that mounting deficits, brought about by increased demands for health services and expanded curricula, have made it necessary for the schools to seek additional annual private support from industry.

The national fund awarded grants of over $3 million to medical schools last year. It was formed in 1949 under the leadership of President Dwight Eisenhower, then head of Columbia University; former President Herbert Hoover, who is honorary chairman of the fund's board; Dr. James B. Conant; and other education and business leaders.

Bailey noted that scientific advances emanating from medical schools have added 21 years to the average life span in the past 50 years—an incalculable contribution not only to humanity but to industrial productivity.

A graduate of Oberlin College, Bailey joined Warner & Swasey in 1919. He became a director of the company in 1942 and president in 1955.

Chicago Chairman Helps the Handicapped

E. CLARK SHAFER, chairman of ASTME's Chicago chapter, has a lot of people at Paraplegics Mfg. Co., Inc., feeling mighty grateful toward him. More than five years ago Shafer took an interest in the problems hindering the early growth of this company which now employs over 100 physically handicapped men and women. So sincere was his interest and so successful his contributions, Shafer was made a director and vice president of manufacturing at the Franklin Park, Ill., company.

Also the president of the Brett Machinery Co. of Chicago, Shafer began his career as a tool and die designer. This experience made him realize that special tools would compensate for the physical limitations of Paraplegics' employees. Long hours without pay went into designing equipment that provided otherwise dependent men and women with a means of supporting themselves and their families.

The special tools and fixtures designed by Shafer in his spare time enable the employees, who own and operate Paraplegics Mfg. Co., to reach the full standards of productivity and workmanship on countless operations that in the past have been impossible for handicapped people to perform.

The Chicago chapter chairman's developments have provided productive employment at full industry standard rates of pay in the company's plants for workers who have suffered the loss of sight, hearing, legs or arms, as well as others with limited physical capabilities. Also, as a result of Shafer's special tooling, the company competes in the open market for electrical, electronic and mechanical fabrication and assembly business.

E. Clark Shafer observes a soldering operation as it is performed by an employee at Paraplegics Mfg. Co., Inc. Special equipment designed by Shafer has made it possible for the handicapped to overcome disabilities and lead normal productive lives.

From Cubits To Size Blocks

Although the recorded history of measurement begins with Noah, well-defined units of measurement did not appear until 1896. In that year Carl Edward Johansson completed his first set of master gage blocks. A sprightly little book written by a HARTFORD chapter member, H. Ford Hannay, traces the history of measurement from the cubit (tip of the middle finger to the tip of the elbow) to the modern era, placing Johansson at its factual, if not chronological, center.

Hannay's book is titled, "From Cubits to Size Blocks."

"Primitive man," writes Hannay, "may have said that a bear is as big as three wolves. We say that a meter is as long as one million microns. . . . This thing called measurement is very much the same now as it was in the beginning. We have still done nothing more or less than to compare an object's size with that of a pre-established master standard. Measurement does not change; it just becomes more complicated."

Both the cubit and the comparatively sophisticated inch of Eli Whitney's day, Hannay declares, had the same defect: they related dimensions to undefined values, leaving their users struggling with one equation in two unknowns. Because Whitney's inch differed from a rival manufacturer's, their gun components were not interchangeable. Thus, although the concept of interchangeability belongs to Whitney, it could not become a practical reality until all measuring devices were calibrated to a universal standard. Establishment of the system of master standards is the legacy bequeathed by Johansson to modern industry.

Inside Story of a Cover

FOR A QUARTER of a century THE TOOL ENGINEER has carried a lot of weight with people in the tooling and manufacturing industry. Beginning next month, it'll carry even more. . . .

Outwardly, the added weight will all be on the magazine's own shoulders—its time-honored and prestigious title will change to THE TOOL AND MANUFACTURING ENGINEER with the September issue.

But the inside story is that the weightier name will more truly reflect the magazine's contents. The contents, in turn, will continue to reflect the interests and concerns of the industry to which the book is dedicated.

In short, with THE TOOL AND MANUFACTURING ENGINEER, you *can* tell a book by its cover.

Editor John W. Greve hailed the projected addition to the title as an inevitable—but much-to-be-desired—result of the growth and expanding scope of the magazine and the Society it represents.

"Not only will the new name more adequately express the contents, but will in addition identify the magazine more closely with its sponsoring American Society of Tool and Manufacturing Engineers," he declared.

Against a backdrop of framed covers of The Tool Engineer, Editor John W. Greve studies an illustration for the new format of The Tool and Manufacturing Engineer. The magazine's title will change with the September issue.

As the 40,000 members well know, they voted only months ago to add "Manufacturing" to the name of the Society itself. They became members of "ASTME" as of Jan. 7, 1960. By a 7½-to-1 majority, they expressed their conviction in a referendum ballot that the expanded name would better describe their duties and functions, and better convey to industry, to educators, and to the general public, the expanding function and importance of tool and manufacturing engineering in the space age.

A dozen years of study and debate preceded the addition to the Society's name. One of the most compelling arguments to change ASTE to ASTME was found right within the pages of this magazine, which has always attempted to mirror the whole range of engineering interests of Society members.

Periodic and impartial research into readership preferences helps determine the magazine's content. Although "tool engineer" in its narrow meaning is often associated only with tooling, that field has been accounting for fewer than one-third of the engineering articles published in THE TOOL ENGINEER. Many others cover processes, materials, management, quality control and other categories of legitimate concern to practicing tool engineers. One hundred percent of the content, however, has been falling within the broader confines of "tool and manufacturing engineer."

The new cover will recognize that the magazine's audience is composed of people of many titles but with one aim—to apply the latest and best method, technique or process to build the best product at the lowest cost and for the most customers.

The change was approved by vote of the ASTME's 16-member Board of Directors, following long studies by the national officers, the National Editorial Committee, the staff and the Society's Long-Range Planning Committee.

The first ASTE JOURNAL, as it was called, appeared in May 1932 soon after the formation of the Society. The first issue called THE TOOL ENGINEER was published in February 1935. The first issue of THE TOOL AND MANUFACTURING ENGINEER will be a logical extension of this long line of significant contributions to the field.

The weightier name, Society leaders feel, has better load-bearing qualities.

Gov. Abraham Ribicoff shows his proclamation of Connecticut Tool and Manufacturing Engineers' Day to A. Douglas Proctor (left), second vice chairman of the host Hartford chapter, and Paul E. Dillberg, general chairman of the day's program. The governor paid tribute to the role played in the life of his state by the 2000 "highly skilled professional workers" who are affiliated with Connecticut ASTME chapters.

Industry's Elite Meet at Hartford

IN SETTING ASIDE a recent spring date as Connecticut Tool and Manufacturing Engineers' Day, Gov. Abraham Ribicoff declared:

"Tool engineers perform a vitally important function in Connecticut by developing the new processes and new tools which keep the industry of this state in the forefront of technological advances.

"Just as the economy of Connecticut depends to a large extent on industry, so industry depends on its tool and manufacturing engineers to keep production lines moving with a minimum expenditure of time, labor and materials."

ASTME has almost 2000 members in Connecticut.

Just how much the state's industries depend on this corps of tool and manufacturing engineers was perhaps indicated by the turnout of industry's elite at the 12th Annual Connecticut Day banquet in Hartford.

Two long head tables of industrial and civic leaders gathered with some 500 members and guests to hear National President Dale Long in the climax of the day's activities. Among them were Malvern J. Mather, president, Allen Mfg. Co.; H. P. Cleaver, works manager, Fuller Brush Co.; William Jarvis,

president, Jarvis Corp.; Philip Marsilius, president of Producto Machine Co. and a national vice president of ASTME; Jacob J. Jaeger, president of Pratt & Whitney Co. and an ASTME honor award winner; A. V. Bodine, president, The Bodine Corp.; Alan S. Cook, vice president, Royal McBee Corp.; Gustav R. Carlson, vice president-engineering, New Britain Machine Co.; Leon J. Dunn, vice president, Veeder-Root, Inc.; A. M. Wright, vice president-engineering, Chandler-Evans Corp.; and many more Connecticut area industrialists of equal stature.

Hundreds Tour Three Plants

Earlier in the day, 125 registrants toured the Chandler-Evans plant in Hartford, makers of fuel control systems and servo mechanisms. A hundred went through the new facilities of the Fuller Brush Co. in East Hartford, where they saw built-in expansionability through improved machinery and automation. Still another group of 80 to 100 toured the sprawling Pratt & Whitney plant in East Hartford, with its sophisticated examples of machining operations, flo-turning and titanium welding.

All of them gathered in the afternoon at a downtown hotel to hear development engineer John W. Meier of nearby Hamilton Standard Div., United Aircraft, explain the Hamilton-Zeiss electron beam equipment and its application to metal processing. Meier said the electron beam welding machine, with its deep, narrow, wedge-shaped weld zone, can weld most materials satisfactorily with these advantages over other methods: concise control of variables, low total energy requirement (not enough to distort workpiece), speed, versatility, and ability to weld dissimilar materials (aluminum to zirconium, etc.). The technique is especially applicable to exotic metals that are susceptible to contamination by the atmosphere, he pointed out.

Electron Beam Cutter Previewed

Meier also previewed the electron beam cutting machine. He said the machine, whose pulsed beams locally vaporize the workpiece, would cut diamond, tungsten or any material. Currently it is being used to cut and pierce tiny Swiss watch jewels at the rate of one every six seconds. Beam deflection control brings precision to small contoured cuts, he said.

General chairman of Connecticut Day was Paul E. Dillberg of host Chapter 7. Henry E. Kuryla of Hartford, a member of the National Public Relations Committee, handled the plant visits. Registrants came from the other state chapters, New Haven, Fairfield County and Central Connecticut, as well as from surrounding states. Banquet toastmaster was Edmond Morancey, general sales manager of United Tool & Die Co. and past chairman of Hartford. Included among ASTME notables present were two national directors, Joseph L. Petz and Wilfred J. Pender, and two past presidents, Irwin F. Holland and Ray Morris.

Some members of the "National Family" line up during reception at Connecticut Day. Left to right are Past President Ray Morris; President Dale Long; Past President Irwin F. Holland; Paul Dillberg, general chairman of the day's program and National Directors Wilfred J. Pender and Joseph L. Petz.

Members in the News

Formerly vice president of the Crane Carrier Corp. of Tulsa, EUGENE A. PELIZZONI of Tulsa chapter has joined Highway Trailer Co. as director of manufacturing. Prior to his 2½-year association with Crane Carrier, Pelizzoni held a similar position with the American Tractor Corp. He was also associated with Motor Products Corp. and Mack Trucks, Inc. He is a licensed professional engineer in the state of Pennsylvania and in 1950 served as chartering chairman of Lehigh Valley ASTME chapter.

After 30 years of service with Gisholt Machine Co., WOODBRIDGE BISSELL of Madison chapter has retired from his position as production manager. Bissell came to Gisholt in 1929 after eight years spent in the steel-making field in Gary, Ind., and in 1930 was promoted to the position he held upon retirement. . . . JOHN C. WESTON, also a Madison chapter member, who joined Gisholt in 1942, has been appointed to fill the position left vacant by Bissell's retirement. Weston progressed from apprenticeship through a number of assignments to chief inspector in 1937, which position he held until his recent appointment.

WILLIAM KELLER and EUGENE KOENIG, members of Northern New Jersey, have been appointed vice presidents of Keuffel & Esser Co. With K&E since 1946, Keller is assistant to A. W. Keuffel, head of the company's manufacturing operations. He is also a director and manufacturing manager of reproduction products, a position to which he was appointed in 1937. Koenig has been with the company since 1934, serving as plant engineer and supervisor of the standards and methods department, becoming head of the instrument department in 1950. This year Koenig was named director of the newly established Optics & Metrology Div.

In line with an expansion of the engineering, manufacturing and sales divisions of Cleco Air Tools, a division of Reed Roller Bit Co., J. A. GRUNDY of Houston chapter has been made general manager in addition to his duties as vice president-operations for Reed. Grundy joined Reed in 1937 as an engineer. He is a member of Reed's board of directors.

WILLIAM C. ALLEN of the Pittsburgh chapter has joined Haloid Xerox Inc. as vice president in charge of machine manufacturing. The company makes copying machines. During his former association with International Telephone and Telegraph Corp., Allen was a member of the product planning strategy committee, being responsible for the development of manufacturing policies, operations and organization. Prior to joining I T & T in 1958, he was for five years the director of manufacturing planning at Westinghouse Electric Co. and before that was connected with Hotpoint Co., a division of General Electric Co., and American Machine and Foundry Co.

Steel Treating, Inc., has announced the appointment of BEN W. DENNIS, member of Des Moines chapter, as vice president. Dennis will continue as general manager, a position he assumed when he joined the company in 1959. Prior to his connection with Steel Treating, Dennis was with the Solar Aircraft Co., serving as production metallurgist and supervisor of heat-treating and processing of metals.

Woodbridge Bissell

John C. Weston

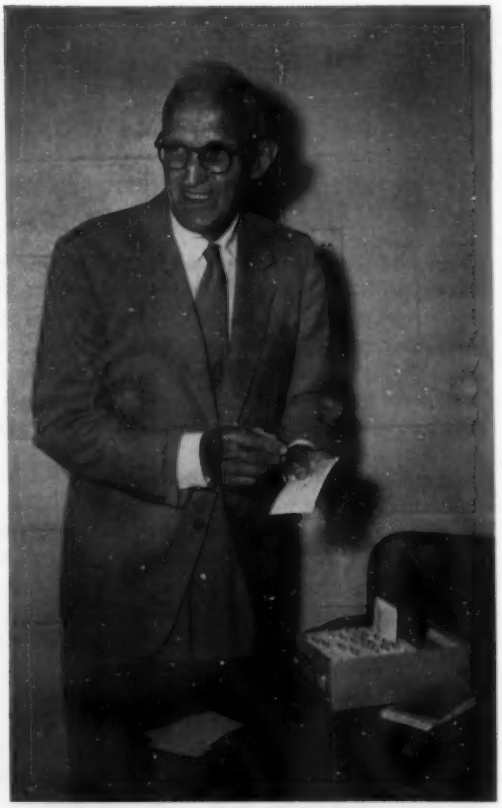
J. A. Grundy

Ben W. Dennis

QUOTE OF THE MONTH: "Why have we tool engineers made the job of tooling so complicated? What has happened to the straightforward approach to tool designing? The words 'human element' have become so involved in our thinking that we have forgotten that the operator of a machine is a fairly reliable, thinking human being. We have been spending so much time trying to get rid of him that we are now outguessing ourselves. We are wasting hours and dollars trying to save minutes and pennies."—Harry M. Betts of Dolan Industrial Sales, chairman of HOUSTON chapter.

CHIPS AND CHATTER

Geiger counter saw double at the recent father and son program of LOUIS JOLIET chapter. Robert Hook (right), chief metallurgist at Warner & Swasey, presented a technical program on "Isotopes in Industry"—and later explained what makes a Geiger counter tick for Waren B. and Oren L. Miller, 10-year-old twin sons of Oren B. Miller. Miller is machine shop foreman at Caterpillar's plant in Joliet, Ill. —*Gene Senn*



Labor of love—a thousand-card index of 1955-to-present issues of THE TOOL ENGINEER—is shown by 72-year-old Henry L. Fisher during a recent visit to the magazine editorial offices at ASTME Headquarters. Fisher spent nine months, at half-time or more, typing the master sets of the abstracting and indexing file on a well-preserved 1924 portable typewriter. He has supplied copies of the index to his old boss at the Hughes Tool Co. and to the University of Houston Library. If anyone wants a guide to those stacks of past but still pertinent issues of THE TOOL ENGINEER, Fisher is in the business from his Houston home. He will also service each set each month to keep it up to date.

Fisher and his wife came on to Detroit from a signal honor at Wheaton, Ill. A 1910 graduate of Wheaton College, he attended the centennial commencement exercises at the school as the only representative of the 50-year class. His grandfather founded Wheaton in 1860. Also a 1914 mechanical engineering graduate of the University of Illinois, Fisher retired in 1958 after 17 years with Hughes Tool. Other than his indexing and traveling (he started on a round-the-world tour the day after retirement, and plans a trip to Russia next year), Fisher fills in as a manufacturing analysis instructor at the University of Houston. And he attends all of the HOUSTON chapter meetings.

chapter news

Tucson chapter's assistant education chairman, Walter Dumas, demonstrates the visual aids which he and other chapter members used in personal visits to promote the design contest in area high schools. Attached to the board are contest rules, problems, and piece parts placed on hooks in a before-and-after condition. Dumas is one of Tucson's student members at the University of Arizona.

Tucson's Contest Designed To Make Friends in Community

TUCSON, Ariz.—When Chapter 106 gave out the prizes in its second annual Tool Design Contest recently, it posted at least one senior member at each table at which guests were seated. The result was a good time—and good public relations.

Comments from the guests also furnished food for thought as the chapter started its planning for the 1961 competition.

The chapter's guests included not only the top three winners from two of the area high schools, but also top contenders from four other participating schools. Along with the boys came their fathers (all but one) and their mechanical arts teachers.

First prize, a $100 Savings Bond, went to Tom Currie. W. C. DeFer won a micrometer for second prize and James Pekarcik won a Vernier caliper for third.

A chart showing the outstanding entries was before the audience during the dinner. For suspense, the first, second and third-place stickers were not placed on the winning drawings until Prof. A. G. Foster, chapter education chairman, had announced them.

Permission was obtained from the state Interscholastic Association to stage the contest. Among other promotional efforts, copies of THE TOOL ENGINEER were distributed among interested schools. Following last year's experience, in which five options made the contest judging quite difficult, the contestants were offered a single option this year.

As Tucson Education Chairman A. G. Foster beams, high school winners and runners-up in the tool design contest line up for congratulations at award night. Left to right are Maurice Sinks, Jr., David J. Carlson, Tom Palmer, Robert G. Patrick; James Pekarcik, third prize; W. C. DeFer, second; and Tom Currie, first-prize winner. Along with the students, the chapter also hosted fathers and teachers.

The design was prepared with the help of Foster's tool design class at the University of Arizona. The class also joined with Foster and with Chapter Chairman Stephen Cassedy in judging of entries.

—George A. Moritz

Brainstorming Demonstration Highlights Seattle Meeting

SEATTLE—An investigation into new brainstorming techniques was conducted by Charles Clark, management development coordinator for Boeing Airplane Co. and author of the book "Brainstorming" at Chapter 39's recent meeting. Clark demonstrated methods he used with armed forces groups at the Pentagon and with numerous research, oil, and engineering organizations in order to develop new ideas.

Clark divided the Seattle members into six-man teams and gave them actual problems to work out. After the principles of creative thinking had been explained by the speaker and the members given a framework in which to operate, new ideas came thick and fast. In a six-minute trial session over 120 ideas were turned in on the subject: "How Can ASTME Be of Better Service to Its Members?"

The meeting's second speaker was Allen Oakley, ASTME member and an employee of Boeing Airplane Co. He talked on photo stress, a new field which has wide application in airframe manufacture. Essentially, Oakley said, the process consists of attaching a plastic strip to the material being tested and watching it change color during the application of stress.

—Ray Clift

Student Chapter 15 Completes First Section of Design Text

LONG BEACH CITY COLLEGE—A formal meeting between officials and students at Long Beach City College and the chairman of ASTME's National Technical Publications Committee, Raymond E. Gariss, marked the presentation of the first completed manuscript for the Society's proposed Tool Design textbook. The desire to belong and to participate in the development of "Section 7000, Fundamentals of Tool Design" enabled the student chapter at the Long Beach school to recruit a number of new members for ASTME.

Student Chapter 15's chairman, William Wright, turned the finished manuscript over to Gariss in the office of retiring Dean J. E. Hollingsworth, an ASTME Gold Medal winner. Leo Gable, Long Beach City College's dean of instruction and a member of ASTME; John Sprinkel, Chapter 15 faculty adviser; and Dr. Ernest Brind, an instructor at the school, also witnessed the event.

special events

Long-Range Planning Committee Meeting	Aug. 6-7, '60	Dearborn Inn Dearborn, Mich.
ASTME Semiannual Meeting	Nov. 14-18, '60	Ambassador Hotel Los Angeles, Calif.
ASTME Western Tool Show	Nov. 14-18, '60	Memorial Sports Arena Los Angeles, Calif.

Saginaw Valley Takes Part In Michigan Week Activities

SAGINAW VALLEY—Working in cooperation with Flint Junior College, the Flint Board of Education, the Charles Stewart Mott Foundation, and a number of other technical societies, Chapter 68 launched the Michigan Week celebration in the Genesee County area at its May meeting. Some 350 persons were invited to attend the affair. The vice president of General Motors Corp. and general manager of the AC Spark Plug Div., Joseph A. Anderson, was the keynote speaker for the dinner meeting. Another guest was ASTME President H. Dale Long.

The Saginaw Valley chapter also took part in a day-long technical symposium held on the campus of the Flint Junior College and devoted to discussions of "Materials in Engineering." Michael Hresko represented ASTME on the program committee for this symposium. Among those topics presented were "Materials Engineering—Fad or Future," "Frontiers in Nonferrous Metallurgy," "Materials for the Automobile of the Future," "Electrical Discharge Machining," and "Cold Extrusion of Steel." What the future holds in the fields of ceramics and plastics was also considered. The final event on the program was a dinner which featured John Campbell, scientific director of the GM Research Laboratories. His talk dealt with "Science, Technology, and Human Progress."

Working in conjunction with the ASTME in staging the materials symposium were the area chapters of the American Chemical Society, American Society for Metals, American Ceramic Society, American Foundrymen's Society, and Society of Automotive Engineers.

—George Steed

Chapter 107 Sees Publishing Plant

KNOXVILLE-OAK RIDGE—The second in a series of plant tours was conducted for the members of

Chapter 107 this May. A tour of the publishing plant of the *Knoxville News-Sentinel* was scheduled as a general interest activity. It took on a more technical nature, however, when the members realized the similarities between techniques used in publishing a newspaper and those employed in the machining industry.

A type of chemical milling was witnessed in the treatment of the plates to reproduce pictures and advertisements for newspapers. The presses and dies used to form printing surfaces and the printing presses themselves were also of interest to the visiting tool and manufacturing engineers.

—R. D. Ellingson

Panel Considers Numerical Control at Denver Seminar

DENVER—An all-day session devoted to an "Introduction to Numerical Control" constituted Chapter 77's June meeting. More than 70 persons attended the Saturday affair, which was described by its ASTME promoters as "an effort to bring the latest available information on a timely subject to regional industry."

Those attending heard a panel of numerical control experts, all authorities in their respective fields of research and development, production and manufacturing. Chairman of the event was A. L. Gossman, who received the Denver chapter's service award pin for his work in organizing the seminar.

The morning session was turned over to R. W. Drayer, program control specialist from the General Electric Co., whose topic was "Discreet Positioning Control Systems." Also on the morning program was R. Nelson of Bendix Corp. Nelson, who substituted at the last minute for J. R. Ballinger, explained "Continuous Path Control Systems."

Following a luncheon, ASTME National Director Leslie C. Seager consolidated the two morning topics by summarizing both the capabilities and limitations of numerical control. Seager covered the subject thoroughly in a talk entitled "Economic Justification of Numerical Control."

Considering the question and answer period a vital part of any conference, the Denver chapter invited A. J. Fria, chief of advance facilities planning at the Martin Co. in Denver, to moderate the final part of the program.

—Alan T. Montgomery

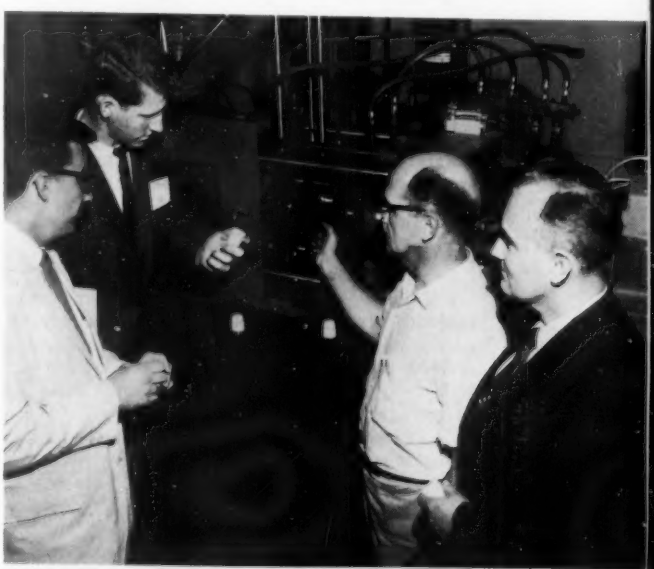
ASTME Chapter 89 Plays "Big Brother" to JETS

GREATER LANCASTER—Chapter 89 invited the 14 members of the Junior Engineering Technical Society chapter at Catholic High School to tour six of the manufacturing plants in the Lancaster area. The JETS group, one of 750 throughout the country, consists of 12 boys and two girls.

Greater Lancaster Chapter Chairman Harry B. Medsger, along with his executive committee, arranged for tours to be conducted at the Armstrong Cork Co.'s research and development center, the Radio Corp. of America, Buchart Associates, The Fuller Co., Garden Spot Airport, and U. S. Asbestos. In groups of two and three the JETS visited one of the plants accompanied on their trips by employees acting as guides and explaining the engineering functions of each department.

The visits over, the students were asked to comment on what they had gained from the "Big Brother Day." A typical remark came from Sheila Renqquist who toured the local RCA facilities. "This day will always remain in my mind as a delightful and interesting experience. It has been valuable also in laying a foundation for my career." Mary Ann Schick had this to say: "I think that this program should be a must in the JETS annual schedule from now on. The points I picked up on this trip and the experience I gained could not be found in any book." Bill Byrd summed up the feelings of all the JETS following his visit to Buchart Associates, a Lancaster architectural and engineering firm. "By all means," he said, "let's have this 'Big Brother Day' again!"

—Richard J. Kintzi



JETS Michael Homsher and Robert St. Clair listen as lab technician Russell Brinser of Armstrong Cork Co. explains the manufacture of plastic caps by means of a plastic molding machine. At right is Richard J. Kintzi, Chapter 89's public relations chairman.

Dimensional Air Gaging Analyzed by Authority

LONG BEACH—Some 60 members of Chapter 84 were exposed to an analysis of "Dimensional Gaging with Air" at their May meeting. Ralph H. Chapman, an authority on gaging sponsored by the Federal Products Corp., was the speaker.

Dimensional air gaging, Chapman began, is the method of measuring a dimension by indicating on a meter the restriction of air flow between a gaging member and a workpiece. It usually consists of a compact unit made up of a filter, pressure regulator, Zero restrictor, and a means of reading variations either by a dial or a float within a tube. This is called the noncontact type of gaging, he said.

A basic type of air gaging is the differential-fixed type gage. Chapman proceeded to explain the principle involved which is similar to that of a "Wheatstone Bridge." Filtered compressed air is pressure regulated and fed into two opposing channels where the pressure is precisely equalized by nonadjustable jets. Air in one channel escapes through the gaging member or air plug. In the other, it escapes into the atmosphere through a Zero setting valve. These two channels are connected by a differential air meter.

Continuing, Chapman said that air escaping through the Zero setting valve is balanced with air escaping between the escaping member and the one master needed to set the gage. When the workpiece is gaged, any change in the air pressure because of variation of workpiece size from the size of the master is translated by the differential meter into linear measurements on its dial. This system has stability, reproducibility and calibrated accuracy.

The speaker told the Long Beach chapter members that the air gage is very versatile. It can be applied to the most simple job or to a very complex one; from inside diameter to electronics for automatic control for machines. —*Paul J. Bodnar*

ASTME Members Plan Tour of British Plants

A two-week tour of industrial England and Scotland is being arranged by Society members in the Detroit area. Detroit will be the start and finish of the tour, which is scheduled for Sept. 27 to Oct. 10.

Edward M. Till, second vice chairman of Chapter 1, and William Germani, head of the chapter's carbide program, are serving on the special tour committee. Others actively promoting the overseas visit are Wayne Kay of Macomb chapter and Past National President Les B. Bellamy.

Several plant tours have been organized for the Edinburgh, Birmingham and London areas. Included are British Motor Corp., Rolls-Royce, Armstrong Whitworth Co. and Ford. Sponsors promise adequate free time between organized activities. A climactic last week end in Paris is on the agenda.

At one point, a trade luncheon in London will bring together the touring ASTME members and members of the British Tool & Gage Makers Association. Another luncheon will be hosted by Lord Rootes.

Reservations from anyone interested can be made with one of the tour backers. The trip quota of 75 persons is not yet subscribed, according to Kay. Total cost is $550, including transportation and accommodations.

Tracer and Numerical Control Compared at Los Angeles Meeting

LOS ANGELES—Paul J. Weaver, consulting mechanical engineer retained by True-Tracer Corp. to apply custom valve design and automatic control circuitry to their line of tracer and machine tool control equipment, was the guest speaker at Chapter 27's June meeting. "Tracer Control Versus Numerical Control" was the theme of his presentation.

Beginning with a brief history of the evolution from handmade parts to mass production of interchangeable machine parts, Weaver proceeded to discuss the use of tracer controlled equipment, numerically controlled equipment, and the advantages and disadvantages of each.

Through the courtesy of the Los Angeles Div. of North American Aviation, Inc., a film depicting the development of the X-15 was shown at this same meeting. Recent experimental flights taken by the aircraft were featured in this film.

—*Brian Mahoney*

CALIFORNIA POLYTECH—Viewing the die-casting display used by a recent meeting's guest speaker H. L. Harvill (second from right) are some members of Student Chapter 12. From left they are James M. Ryan, James Barth and Dick Jacobs.
—Leonard H. James

SOUTHERN TECH.—National Program Committeeman Charles Bolden installed Student Chapter 16's new officers at a recent meeting. Taking the oath from Bolden are (left to right) Chairman Wayne Perry, Secretary Jim Hewell and Treasurer Tom Miller. ***—L. G. Cuba***

MOHAWK VALLEY TECH—Both winners of $50 awards for scholastic achievement, Ed P. Moran (left) and Robert P. Hall, accept congratulations from Chairman Don T. McKay of Mohawk Valley chapter, bestower of the gifts. Moran and Hall, shown here with instructor John T. Dizer, are seniors and ASTME student members at Mohawk Valley Technical Institute Chapter 10. ***—Edward W. Jones***

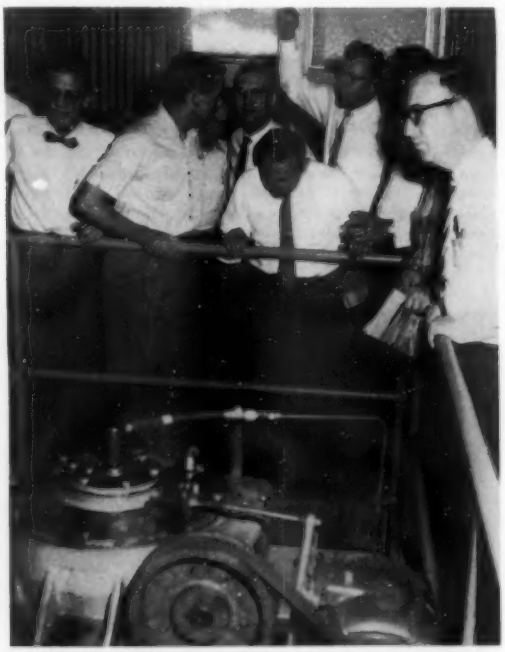
ASHTABULA COUNTY—As part of a project which designates that a *Tool Engineers Handbook* go to every one of the five libraries in the area, Warren Moran, chairman of Chapter 127, presents one of the books to Miss Allen, director of the Carnegie Library at Conneaut, Ohio. James Wolf, superintendent of the Conneaut school district, witnesses the presentation which took place at a recent meeting.

ROCKFORD—Mechanical drafting students from Rockford, Freeport and Beloit received Chapter 12's annual high school awards. Here Chairman H. Walter Lewis presents the prizes, which ranged from $25 to $10, to (left to right) James Grieves, Gordon Swanlund, Mike Arndt, Victor Nania, Miles Cremer and Michael LaVelle. ***—R. C. Bowen***

MERRIMACK VALLEY—National Director Joseph L. Petz (left) was the installing officer at Chapter 113's installation meeting. Taking the oath of office from Petz were (left to right) Leon Rice, Jr., chairman; Alsdon Arold, first vice chairman; Alfred King, second vice chairman; Marc Lefebvre, secretary; and Dante Patti, treasurer. ***—Leighton L. Reynolds***

HENDRICK HUDSON—Three members of Chapter 114, part of the group that recently toured the American Saw & Manufacturing Co., hear about the techniques used in hacksaw-blade production. From left they are Gennaro D. DeRubertis and Benet Ripin, Chapter 114 chairman and first vice chairman; Antonio Gallo, foreman of the company's hacksaw-blade department; and Peter P. Kazle. The tour, which lasted a day, attracted some 20 members of the Hendrick Hudson chapter.

GRAND RAPIDS—Chairman Ivan Haan took enough time out of Chapter 38's recent plant tour of the Universal Joint Div. of Rockwell Standard Corp. to present member James Wagner with the 1960 service award pin. Wagner is the chapter's advertising agent.
—Ray Kutschinski



HOUSTON—Members of Chapter 29 listen to an explanation of one of the refining stages that raw sugar goes through during their visit to the Imperial Sugar Co. in Sugar Land, Texas. Among those who took the tour was National Director Dean Saurenman.
—Leland V. Dolan

Reports in Brief . . .

Midwest

Beginning with the issuance of the first patent governing canal boat operation in Florence, Italy, in 1420, patent attorney Robert E. Woodhams of Woodhams, Blanchard & Flynn, outlined the history of patent laws for 60 members of the KALAMAZOO chapter this May. Woodhams put particular emphasis on the laws governing patents on engineering processes. . . . Some 200 DETROIT chapter members boarded a train for Rockford, Ill., and tours of Greenlee Bros. & Co. and Sundstrand Corp. in June. The trip constituted another one of Chapter 1's annual out-of-town plant tours. . . . Joseph Nitkiewic, chief research engineer of Ex-Cell-O Corp.'s numerical control department, addressed the members of the CANTON chapter at their May meeting. After briefly orienting the group on the development of numerical control, Nitkiewic narrated a film which showed actual applications of the process. . . . ASTME national vice president, David A. Schrom, was featured as guest speaker at LANSING's past chairmen night. Among those in the audience who heard Schrom discuss the "squareness" of tool engineers were John W. Greve, editor of THE TOOL ENGINEER; Executive Secretary Harry E. Conrad; Research Director Leslie S. Fletcher; John W. Groomes, administrative assistant to the executive secretary; and Philip D. Harvey, assistant technical director. . . . Chief engineer at the Paramount Engineering Co., DETROIT chapter member John H. Meyn died on May 27.

Northeast

A tour through the Carnation Milk Co. and the presentation of four awards for scholastic achievement were the highlights of the ERIE chapter's May meeting. Two students from Alliance College, Thomas Watt and John Sonnet, and two from Behrend Center, an extension of Penn State, Charles Flick and James N. Reed, were the winners of the scholarship awards. . . . Recently 60 members of GREATER LANCASTER visited the New Holland Machine Co., where they saw "Design Decisions," the theme of the tour, being carried out. Willis M. Houck, a member of Chapter 89, was the tour moderator. . . . A talk on "Magnesium for Production and Experimental Tooling," presented by Herb Buzzard, manager of magnesium products at A. R. Purdy Steel Co., and Gary Grochowsky of the sales department at Dow Metal Products Co., attracted 40 members and guests to the June meeting of the PATERSON chapter. . . . KEYSTONE chapter's May meeting featured National Director Joseph L. Petz as guest speaker. Describing the advances made in technology during the past 20 years, Petz called those men who have failed to keep abreast of these advances "the Rip Van Winkles of the engineering world." . . . H. Cadwallader, Jr., a member of the PHILADELPHIA chapter, passed away this May. He was president of Standard Equipment Co.

West Coast

In his talk before 86 GOLDEN GATE chapter members the sales manager of the Durable Punch Co., L. Worthington Dodd, illustrated how, through precise heat treating and punching depths two to three inches deeper, punches being manufactured today are of higher quality, longer lived and lower cost than the "homemade" variety of the past. The problems confronting the metals industry in San Francisco Bay area were discussed at this same May meeting by R. R. Grunsky, managing director of the California Metal Trades Association.

positions wanted

AERONAUTICAL ENGINEER—living at Orlando, Fla., with liaison background, would like to contact industries needing southern sales representation. Phone GA. 5-3343, nights; CH. 1-4576, days, or contact 10700 Puritan Ave., Detroit.

PRODUCTION GEAR SUPERVISOR AND TECHNICIAN—Thirty years' experience in manufacturing and inspection of gears, all types—fine pitch, engine, traction and aircraft. Production supervisor from foreman to superintendent. Have written five articles for periodicals. Served on several AGMA technical committees. Relocating no problem. Resume upon request. Write to Classified Ad Dept., Dept. 181, 10700 Puritan Av., Detroit 38, Mich.

positions available

MANUFACTURING ENGINEER—with powder metallurgy experience for expanding eastern tungsten carbide manufacturer. Write to Classified Ads, Dept. 182, 10700 Puritan Ave., Detroit 38, Mich.

FIBERGLASS PLASTIC TOOLING AND PARTS—Custom manufacturer of epoxy resin and polyester resin reinforced plastic tools and parts needs representatives in many states. Company's products are well received and name is well respected. A young industry with a very good future. Write to Mr. Lawrence A. Wallisch, Jr., Sales Mgr., Latrobe Plastic Co., 310 Unity St., Latrobe, Pa.

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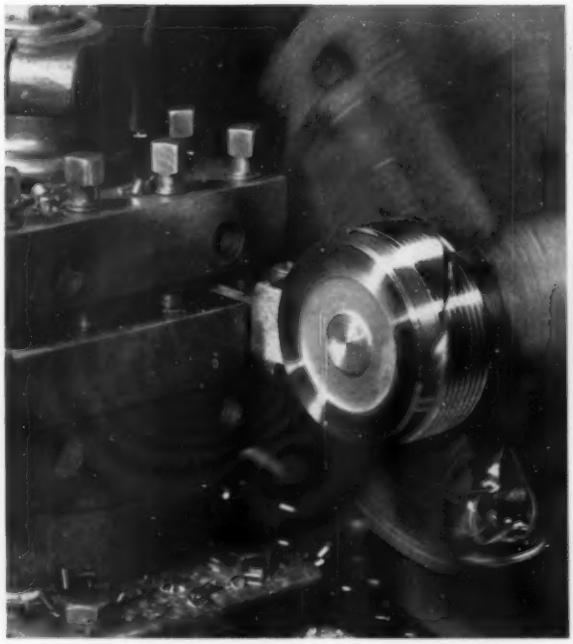
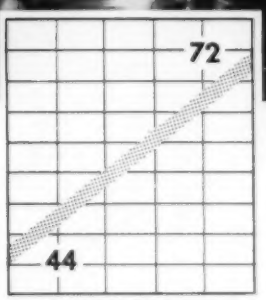
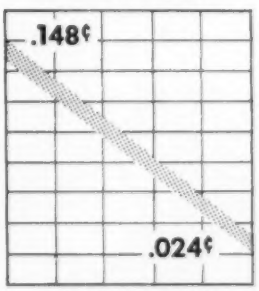




PIECES PER SHIFT



COST PER PIECE

NEW IDEA at MISSION

MISSION MANUFACTURING CO., Houston, Texas, manufacturers of oil field and industrial equipment, now cuts threads using negative rake throw-away tooling with standard precision VR-73 inserts. Production has increased from 44 to 72 pieces per 8 hour shift. Threading tool costs have been cut 83% — from .148¢ to .024¢ per piece. Carbide grade VR-73 produces 3 times the pieces per cutting edge. The throw-away feature allows accurate indexing without tool changes and costly set-ups. These benefits are not obtainable with the previously used brazed tool. This new idea in tooling has also given Mission greater accuracy, improved finish and more consistent production. *Call your V-R man today. Write for fully illustrated catalog.*

CREATING THE METALS THAT SHAPE THE FUTURE

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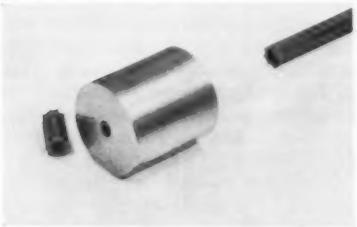
Progress in Production

ALUMINUM PARTS EXTRUDED FROM POWDER METAL SLUGS

A new family of precision aluminum parts has resulted from an impact-extrusion process developed by Aluminum Company of America. Contrasted with the general application of the powder metallurgy technique to other metals—a technique which involves sintering metal powder directly into finished form—the Alcoa process utilizes powder-metallurgy techniques to form a slug from which a final form is



Impact slug and extruded finned tubing. Small diameter finned tubing can be extruded in lengths up to 14 ft.

impacted. Result is elevation of upper operating temperature limits for high-strength parts.

In theory any part which can be impacted can be fabricated from an APM slug. Normal maximum and minimum size limits for impacts apply to the new process with part tolerance falling well within the normal impact ranges.

Initial application of the impact process is expected in applications where high-temperature performance and property retention of precision parts is mandatory.

IMPROVED PROCESS FOR EXTRUDING STAINLESS STEEL

The Metals Div. of the H. M. Harper Co., Morton Grove, Ill., has developed a manufacturing technique which reduces cost and substantially speeds the production of steel and stainless steel extruded shapes. Using the Ugine-Sejournet glass lubrication pro ess, the technique eliminates one of the most time-consuming steps in shape forming —the process of rolling. Conventional techniques involve casting large ingots which are reheated and rolled into smaller sizes. These are then recut into still smaller sizes, reheated and rolled again. This method of diminishing sizes continues until the material has been rolled into the desired size and shape.

In the new technique, smaller ingots in the range of 5½ to 7½ inch are processed directly by extrusion from the cast material into the finished shape, without the necessity of rolling. Substantially reducing both costs and time required to manufacture a completed shape, the process produces finished products with as much tensile strength, or more, than those made by the conventional hot-rolling method.

SERVO SYSTEM PROVIDES REMOTE CONTROL FOR LATHE

Remote control of a small toolroom lathe has made it possible to machine radioactive material. A complete two axis double-ended servo system provides all necessary operator functions of the lathe at a remote console. Designed and built by United Control Systems, Inc., the equipment is now operational at the Wright Air Development Div., Dayton, Ohio.

The servo system controls longitudinal and cross feeds of the lathe. Other operations, such as loading work, closing collet and changing tools, are performed by manipulators. Longitudinal and cross feed position readout

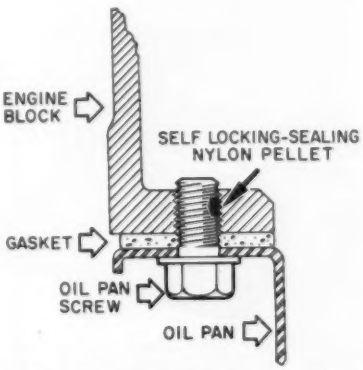
Lathe with console for remote control. Console has carriage and cross-feed handwheels like those of lathe.

are accomplished by means of rack and gear drive to rotary pots. The cross-feed drive consists of a DC motor actuator assembly coupled directly to the cross-feed screw.

If desired, the lathe can be operated conventionally. In this case, the console handwheels follow the lathe handwheels, whether the operator uses the manual or motorized feeds. Thus when the console is placed in control, the handwheels are correctly positioned and no inadvertent motion of the carriage takes place. Likewise, when the operator uses the console, the lathe handwheels follow. Both manual and motorized feed can be accomplished at the console.

SELF-SEALING FASTENER SOLVES GASKET COMPRESSION PROBLEM

Assembly of oil pans to engine blocks without over-compression of gaskets has been a long-standing problem among engine manufacturers. Tests conducted by one major automaker, for example, showed that 40 percent compression



Nylon insert combines sealing ability and locking action. Lowered torque requirements enabled manufacturer to redesign pan and block.

was the maximum that the average cork composition gasket could take without losing its resiliency and essential sealing properties. However, it was also found that between 15 to 18 ft lb of torque were required to obtain proper seating of the oil pan screws. The crux of the problem was how to specify and control assembly procedures when so many mechanical, material and human

variables are involved—and when, too often, proper seating of the fasteners unavoidably results in over-compression of the gasket.

A practical solution to this problem has been supplied by Nylok-Detroit Corp. of Troy, Mich. By permanently embedding a resilient protruding nylon pellet in a blind hole tapped in the threaded section of the oil pan screws, N/D converted the automaker's conventional parts into one-piece self locking-sealing fasteners that do not require high seating loads. At the same time they provide proper uniform gasket compression, as well as worthwhile reductions in engine weight and production costs.

When the processed fasteners are threaded into the engine block, compression of the protruding pellet creates a strong spring like wedging action that locks and seals the mated threads together. This locking-sealing action occurs wherever wrenching stops—whether the part is seated or not—and the constant lateral thrust is sufficient to insure a positive, vibration-proof assembly without the use of lockwashers or sealing compounds. In addition, toughness and resiliency of the nylon pellet are such that the fasteners may be removed and reused as often as necessary without loss of their inherent locking and sealing properties.

Because the compressed pellet also acts as a "dam" to prevent leakage around the threads, engine manufacturers are able to reduce weight by elimination of bosses on the inside flange of the block. Costs are cut by tapping through-holes to receive the self-sealing oil pan screws, thus eliminating the close-tolerance blind holes formerly required.

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Above: Ellstrom Rectangular Set No. 92-R. Right: Ellstrom Square Set No. 81-SA, with accessories.

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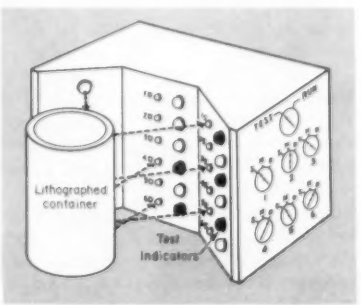
CONTROL SYSTEM SPOTS REJECTS BY CODE

A control problem created by changeover to a more complex product has been solved by a logic system designed by Sterns Control Div., Logic Systems, Inc. in Great Neck, N. Y. Developed for a lithographed container operation, the system monitors orientation of units on the production line and rejects those improperly assembled.

The problem arose because of the container operation's use of machinery originally designed to form a simple unit which, with identical top and bottom, could go down the line without regard to orientation. With the new product, however, proper orientation is a key factor. The units have a completely different top and bottom; consequently, any unit going through the



Lithographed container in front of code detection head. System rejects faulty containers.

line upside down is improperly assembled and ends up as a reject. Because the units travel at an approximate assembly rate of 500 per min, no human operator can spot and reject faulty units fast enough.

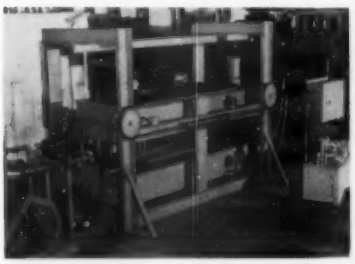
To solve the problem, monitoring is done by a logic system based on a code. The code is the can label. A section of the label that clearly reveals whether or not the unit is improperly oriented

serves as a reference point. As long as a unit coming down the line meets the requirements of this established code, it is allowed to pass. But when the detection head spots a unit with improper orientation or other factors such as improper lithographing, texture, color and quality differences, the faulty unit is automatically rejected from the line.

The system is designed for use with a variety of containers, regardless of physical differences. When a production changeover occurs, a new code based on the new set of physical characteristics can be established.

DIPPING SYSTEM SAVES FLOOR SPACE

Floor space requirements can be reduced as much as 60 percent with a dipping system based on a new concept of dip-tank operation. A dip tank for applying varnish insulation to stators and electric motor windings automatically moves upward to immerse the work, then recedes to enable the work to continue onward. The servicing conveyor can be halted over the tank to allow a longer period of work drainage, if necessary.



Two short tanks placed one over the other in new combination conveying and dip tank system.

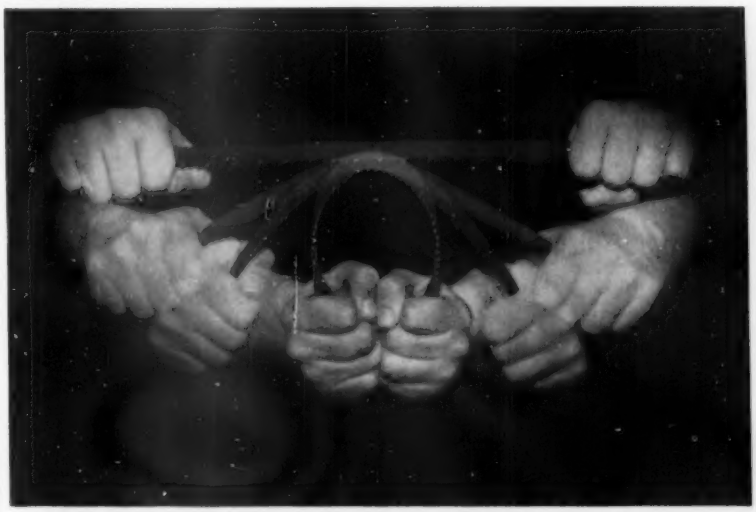
The system provides good control of work withdrawal and constant level of varnish at all times for positive and thorough coating. According to the Industrial Equipment Div. of the R. C. Mahon Co., designers of the system, it can also be used as part of a dip-painting operation in many plant finishing departments.

Normally, in a varnish dip insulating operation, the work comes from a preheat oven, then moves on a conveyor that dips into a stationary, coil-cooled tank. After immersion it gradually climbs out of the tank via the conveyor. For such an operation, the tank usually is extended considerably to provide extra space for gradual work withdrawal and drainage.

In the new system, this space is cut to less than half by the use of two shorter tanks, one placed over the other. Both 8-ft tanks are built into an operating unit that occupies a 6 by 14-ft area.

As in conventional dip-tank procedures, the conveyor from the preheat oven runs over the upper or dip tank of the system, but is designed so it can be stopped to spot the work, suspended from hangers, directly over the dip tank for immersion. The stopping of the conveyor triggers a limit switch, causing the upper tank, in lowered position, to rise to immerse the work. As this movement takes place, the lower or varnish storage tank moves downward. After immersion, the upper tank lowers automatically and the lower tank rises so that the two almost meet. The lower tank serves as a counterweight in the movement, keeps the varnish in the dip tank at proper level and holds the coils to cool the constantly circulated varnish. Movement of the tanks is produced through a hydraulic cylinder, piston and chain drive arrangement, with speed controlled through hydraulic valving.

Moving up a maximum of 13 inches, the dip tank allows immersion up to 9 inches. Although rise, immersion and withdrawal times are adjustable, the dip tank for varnish applications normally rises in 6 seconds. Immersion time is 7 seconds and withdrawal time is 58 seconds, the same time it takes the conveyor to move forward to spot another load.



So it doesn't break---*So what??*

So we can bend a MARVEL High-Speed-Edge Hack Saw Blade double, and it won't break. Does this prove anything?

Let's see if it does. When you buy a box of hack saw blades, you expect each blade to have a reasonable cutting life. For example, take an ordinary blade that costs $4.00, and you expect it to produce 2000 sq. inches of accurate cutting-off before it is discarded. Would you be willing to pay $8.00 for that same blade? *You will, if it breaks halfway through its expected life.*

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Safety to both operator and machine, plus maximum blade life, seem like value enough from this remarkable blade. However, these MARVEL Blades give you even more, for they will cut faster, with greater accuracy because they can be safely tensioned more taut in your machine than ordinary "breakable" blades and are therefore more rigid to resist deflection.

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Thor
POWER TOOLS

TOOLS of today

Multiple Slide and Transfer Press

Available in three and nine-ton capacities, this combination press can blank, pierce, form and bend in one single, continuous operation at speeds up to 100 spm. Division of tooling into separate units provides economy on short run operations. Distortion-free primary blanking insures accuracy.

Tolerances of finished parts are independent of feeding accuracy since the blank is separated from the strip at the first station and positively held for subsequent operations. Bending or twisting of stock is eliminated. All toolholders are individually adjustable for height and changes to new parts are easily made. Each operational stage is separate, making each tool, guide and slide easily accessible without disturbing settings of adjacent stations. A combined roll straightener and feed unit that allows the strip to be fed laterally is available.

E. W. Bliss Co., 1375 Raff Rd., SW., Canton 10, Ohio. **Circle 301**

Double-End Tool Grinder

This machine provides oscillating cup wheel grinding on one end and chipbreaker grinding on the other. It is available in three styles—one style for conventional diamond-wheel grinding and two styles for electrolytic

grinding. As an electrolytic grinder, the machine can be equiped with either a 150-amp Anocut power pack with manual spark control or a regular Anocut power pack with automatic spark control. The three styles of Model CME-66 have the same 1-hp, 3450-rpm motor-on-spindle grinding head. The chipbreaker end is equipped with a vise for grinding in tools up to 2½ inches wide. The cup wheel oscillates at 60 spm and can be set for a stroke length of from 0 to 1½ inches.

Hammond Machinery Builders, Inc., 1661 Douglas Ave., Kalamazoo, Mich. **Circle 302**

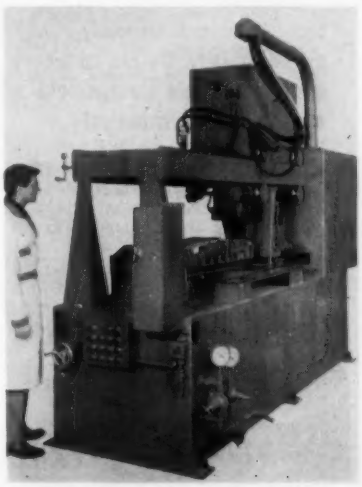
Pneumatic Machinery Mount

Basically a pneumatic servo mechanism, a machinery mount maintains level within 0.0005 inch per foot of length, regardless of load, with a repeatable accuracy better than one-tenth of one percent. The device is installed simply by sliding it under the support points of the equipment. Leveling is accomplished by Allen-wrench adjustment. Operating from shop air supply, the mount automatically compensates for changes in loading, variations in floor level and external and internal thermal changes. Vibration and shock are effectively isolated, since the mounted equipment is supported on a cushion of air. The mount can be used with equipment such as long-bed lathes, jig borers and grinders, and surface plates and similar measuring devices. Use of the mount permits equipment installation without special foundations, drilling, lagging and shimming.

Barry Controls, 700 Pleasant St., Watertown 72, Mass. **Circle 303**

Resistance Seam Welder

Joining strip ends together for continuous processing in tinning, annealing and coil prep lines, this travel-head series seam welder facilitates welding of thin-gage, overlapped coil ends. The



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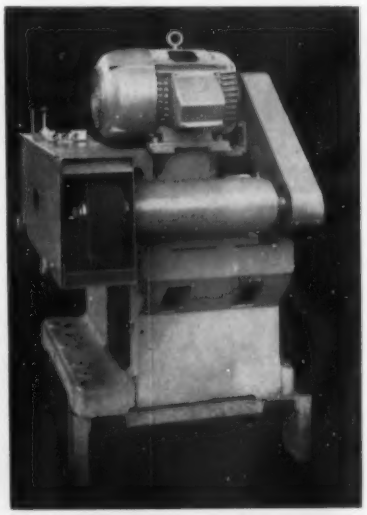
machine has built-in strip shear and automatic weld wheel conditioners. Two punches pierce the strip during clamping in order to identify the weld during later operations. When the first strip is clamped, a gage automatically determines its deviation from normal centerline position and locates a backstop for positioning the rear edge of a second strip for exact alignment. Welding power is automatically applied only to the overlapping strip ends, regardless of width and position in the machine. Total time for shearing, strip handling, punching and welding a 48-inch strip is 12 seconds.

The Taylor Winfield Corp., 1048 Mahoning Ave., Warren, Ohio. **Circle 304**

USE READER SERVICE CARD ON PAGE 131 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Grinding Attachment

Built for mounting on heavy-duty lathes, mills, planers and other machine tools where grinding operations are required, this abrasive belt attachment has a heavy taper nose spindle and is capable of heavy stock removal,

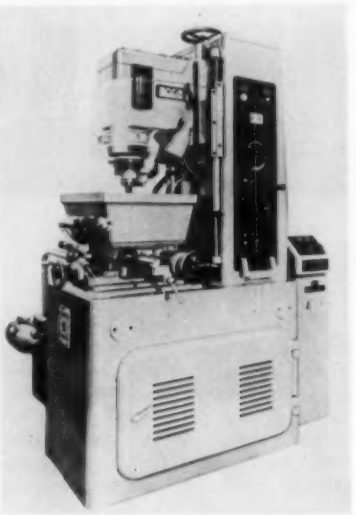


close-tolerance size control and low microinch finishing. The unit can be furnished for right or left-hand assembly and can be mounted in any position. Diameter of the contact wheel is 12 inches. Abrasive belts are up to 4 inches wide and 86 inches long. Heavy-duty and special-order models are available.

Production Machine Co., Wells St., Greenfield, Mass. **Circle 305**

Automatic Electrical Discharge Machines

One of a line of high-precision electrical discharge machines, the Eleroda D1 includes a magnetic electrode holder for working and locating within ± 0.0002 inch, an hydraulic servo

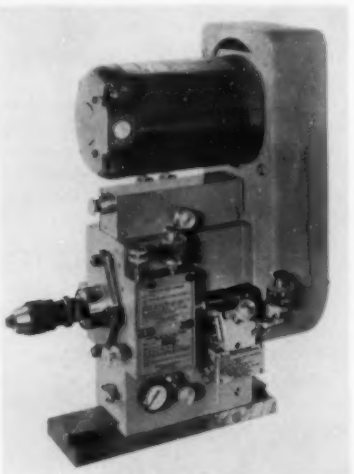


motor, a worktable that provides jig-borer accuracy, and a tubeless electrical power unit. The fully automatic machine provides surface finish of 10 microinches.

Charmilles Engineering Works, Ltd., 25-20 43rd Ave., Long Island City 1, N. Y. **Circle 306**

Drilling, Tapping Unit

Basic secondary operations such as drilling, tapping, threading and reaming can be handled with this high-speed, single spindle automatic unit. The U-A machine an be mounted at

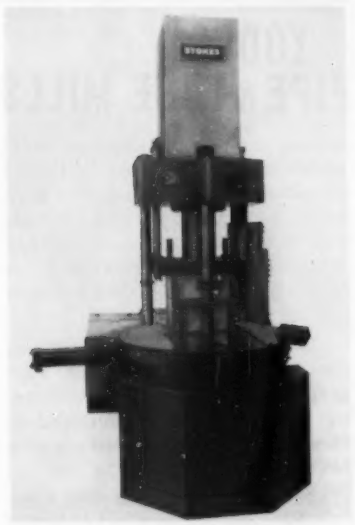


any angle and in any position. Speeds range from 500 to 10,000 rpm. Maximum spindle stroke is 2½ inches, adjustable down to ⅛ inch. In mild steel, drilling capacity is 0.020 to ⅜ inch and/or ⅜-inch tapping. Dovetail mounting permits 5½-inch adjustment of head plus 2½ inches of spindle stroke control. The unit operates on shop air supply of 15 to 100 psi as required.

Universal-Automatic Corp., 9545 Ainslie St., Schiller Park, Ill. **Circle 307**

Insert Molding Press

Model 744 150-ton capacity transfer presses for the molding of plastic parts with inserts provide accurate, fast loading of inserts into the mold. Fast clamping speeds allow use of the presses for compression molding. Principle feature of the press design is a horizontal turntable that carries, at opposite stations, two identical lower mold halves. While one of the halves is in normal molding position within the press for the pressing and curing



phase of the cycle, the other half is outside the press. When the cure cycle is completed and the mold opens, the turntable rotates 180 deg, swinging the freshly loaded mold half into molding position and bringing the other half into the unloading and reloading position.

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. **Circle 308**

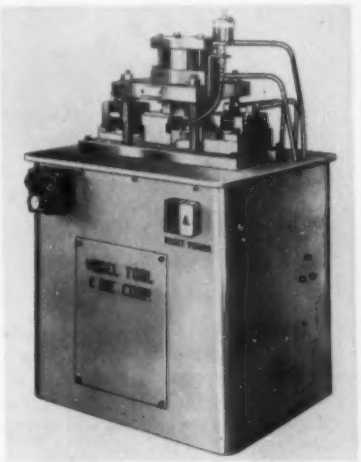
Spot-Welding Unit

Mild steel, galvanized carbon steel, stainless, aluminum and other metals 0.030 to ¼ inch thick can be spot-welded from one side with an inert gas shielded arc spot-welding unit that can also be used to plug weld metals ⅛ inch thick and more. The equipment will also space weld, tack weld and bead weld. It can produce more than 20 spot welds per minute by placing the gun against the work, squeezing and releasing the trigger. Completion of the welding operation is automatic.

Hobart Brothers Co., Troy, N. Y. **Circle 309**

High-Speed Cutoff Machine

Tubing and shapes can be cut into lengths of ½ inch or more with accuracy of ± 0.010 inch at high speeds with this cutoff machine. Designed for either hydraulic or pneumatic operation, the unit is equipped with three



cylinders and pistons. One ram clamps the work to be machined into place and the other two are fitted with shearing blades that make the first and final cuts in quick succession.

Vogel Tool & Die Corp., 1825 N. 32nd Ave., Stone Park, Ill. **Circle 310**

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Resistance Welder

Thin wires and foils can be welded with a stored energy unit that delivers an adjustable range of power of 0.01 to 10 watt-seconds in less than 0.001 second. With automatic voltage regulation, repeatable power is attained even with line voltage fluctuation of ± 20 percent. A variable transformer and silicon rectification eliminate the need for tubes in the charging circuit, providing smooth, stable output. With

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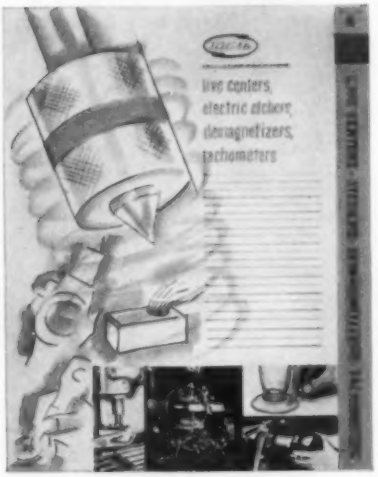

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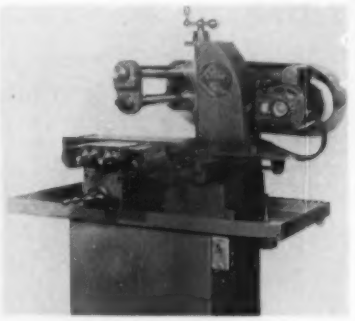
a miniature welding head or tweezers, wires as small as 0.0002 inch can be cross welded with the VTW-28 unit. A pulse width of less than one millisecond assures no burning or discoloration of material.

Vacuum Tube Products Div., Hughes Aircraft Co., 2020 Short St., Oceanside, Calif. **Circle 311**

Light-Duty Milling Machine

Model 624 milling machine has hydraulic feed and infinitely variable table feed of from 0 to 600 ipm in both directions. Table surface is 6 x 24 inches, longitudinal travel is 10 inches and transverse travel is 4½ inches.



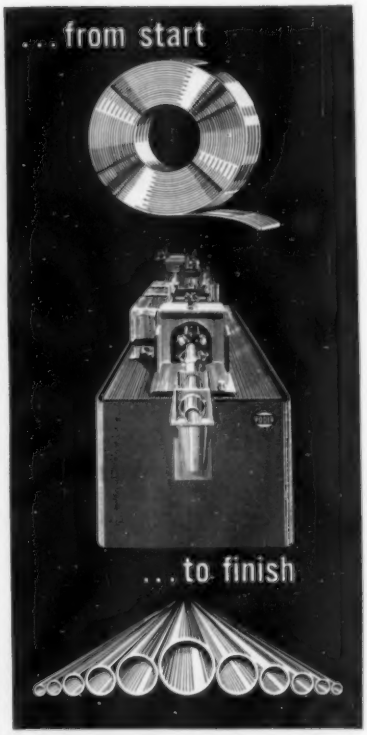
Feed is adjustable from right to left or left to right with rapid return or stop. Spindle can be controlled with production handle or lead screw. Four spindle speeds range from 500 through 2050 rpm.

Northern Illinois Machinists, Crystal Lake Rd., McHenry, Ill. **Circle 312**

USE READER SERVICE CARD ON PAGE 131 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Automatic Turret Lathe

Designed for fast metal removal of tough superalloys, this 15-hp machine has a rigid steel weldment base and hardened and precision ground ways. A six-face turret, standard in the 3E-15 lathe, allows more cuts per cycle. The selector switch cross-slide control panel allows setting of all cross-slide movements by means of a selector switch for each slide. Either on-time or delayed motion relative to the turret motion can be set for front and back slides. The slides can be operated either together or independently with any turret face. The machine provides four automatic speed changes for each



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(ferrous or non-ferrous)

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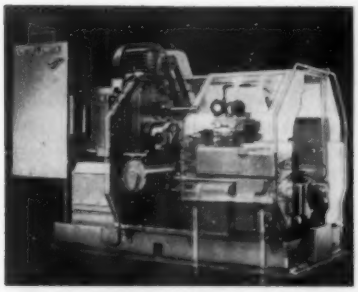
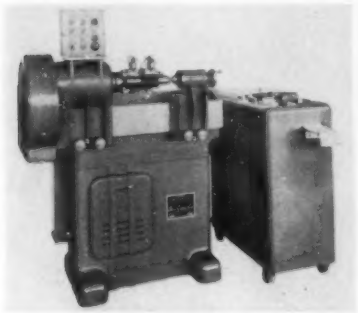


set of speed change gears and six feed changes for each set of feed change gears. Standard speed is 60 to 1540 rpm and feed range per spindle revolution is 0.002 to 0.162 inch. Electric tape control is available as optional equipment.

Pratt & Whitney Co., Inc., West Hartford 1, Conn. **Circle 313**

Lead Analyzer

Inspection and recording of lead measurements on hobs, helical gears, cams and cutting tools are accomplished electronically with this machine. Lead of both sides of the thread is checked and charted simultaneously.



Leads of spiral gashes on form milling cutters and multiple thread milling cutters can also be checked. The analyzer can handle tools or parts up to 16 inches long and 9 inches in diameter. Maximum transducer slide travel is 8 inches.

Star Cutter Co., 34500 Grand River Ave., Farmington, Mich. **Circle 314**

Ultrasonic Machine Tool

Precise machining operations in hard and brittle materials can be done with this compact unit. For low production, the transducer and workstation are mounted horizontally as illustrated. The workpiece is fed into the tool, oscillating 20,000 times a second under controlled spring tension. Machining tools up to two inches in diameter can be used. For high production, the

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transducer is vertically mounted. An adapter transmits high-frequency vibrations to as many as eight separate tools fastened radially to the outer edge. Workstations of the same type illustrated are opposite each tool and can be operated independently or simultaneously. Used as a single-station machine, the unit can machine as many as 300 dice (0.030 x 0.010 inch thick) in a one-inch diam wafer in less than 45 seconds.

The Sheffield Corp., Dayton 1, Ohio. **Circle 315**

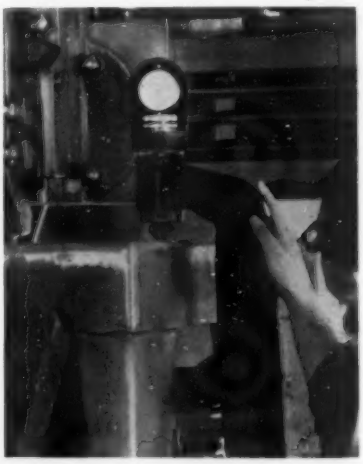
Portable Converters

Self contained, portable, high frequency converters connect to a 220-volt, three-phase, 60-cycle power supply. Four frequencies are available through the two switches. The line has single, four-speed and continuously variable units that allow infinitely variable spindle speeds at constant load speed in a range from 12,000 to 60,000 rpm. One eighth-kw converter will operate the manufacturer's Model 65 power quill or its equivalent. Larger converters, from 1.6 kw, are available.

Precise Products Corp., 3715 Blue River Rd., Racine, Wis. **Circle 316**

Mobile Hardness Tester

Designed for conducting Rockwell hardness tests on large or bulky metal components and work specimens that must be tested on location, this direct-reading unit can also be utilized in shops, toolrooms and inspection departments. The tester consists of a clamping device—C-clamps with various throat sizes—and an indenter head. Test load spring units are interchangeable for different load ranges. Model M-I gives readings in the Rockwell C



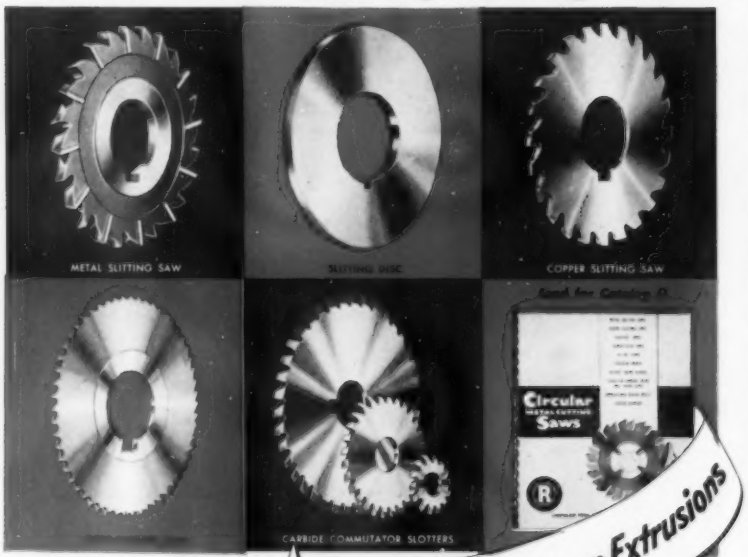
scale with 0 to 6.3-inch distance between the anvil and penetrator and throat depth of 3.3 inches. Weight is 17 lb. Model M-II, which provides readings in the same scale, has an anvil-to-penetrator distance of 0 to 9.8 inches and throat depth of 5.1 inch. Weight is 18 lb. Accessories, including weights for Rockwell A and B scale tests, are available as optional equipment.

Wilson Mechanical Instrument Div., American Chain & Cable Co., Bridgeport 2, Conn. **Circle 317**

Riveting Machine

Equipped with dual feeding mechanisms, Model 111 riveting machine is designed for automatic feeding and setting of both male and female cutlery or compression rivets at the same time.

From More Than 1200 ® Catalog Items...



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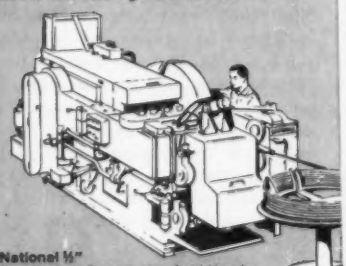
These important parts are cold-formed from coiled wire, start to finish in compact, efficient National Cold Headers.

These parts are formed practically scrapless. All achieve remarkable savings over past methods.

If you make odd-shaped parts, may we help you evaluate them for cold-forming from wire? Better yet, come to Tiffin, witness our demonstrations and let's discuss your work.



National ½" Five-Station Progressive Cold Header

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U.S.A.

HARTFORD DETROIT CHICAGO

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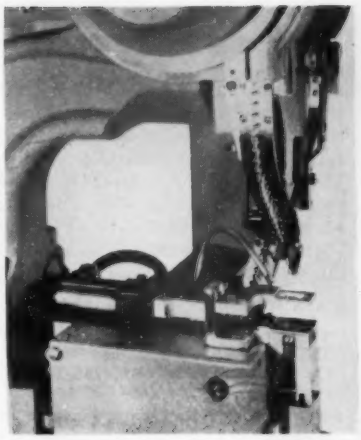


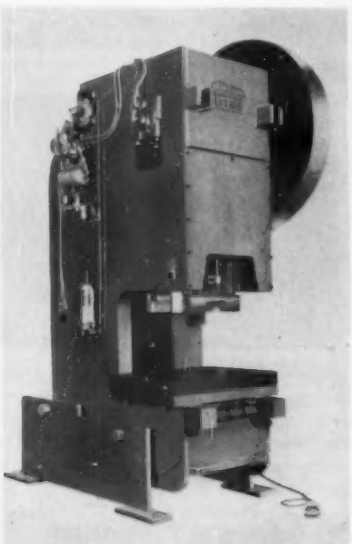
The male rivet is conventionally fed with its head up and the female rivet is fed in an inverted position into the lower jaws where it is held with its head down. The unit is equipped with a combination manual and air-operated hold-down clamp, an automatic air jet to keep the lower jaws clean and an auxiliary hand valve to feed female rivets individually if desired.

Tubular Rivet & Stud Co., Quincy 70, Mass. **Circle 318**

USE READER SERVICE CARD ON PAGE 131 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Inclinable Presses

Presses in a newly designed line have capacities of from 75 to 200 tons, welded steel frames and box type slides. All presses in the line, including the 150-ton 13-I model illustrated, permit free access of material from front to back and right to left. Each



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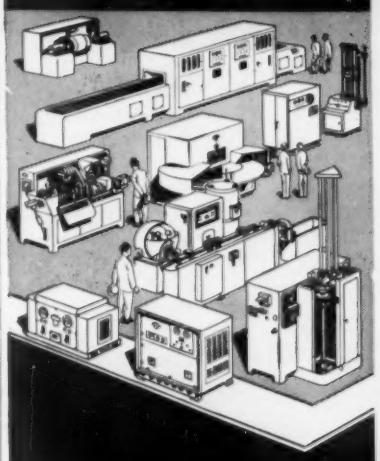

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New York's body drills are specially designed for accelerated assembly lines. You'll find them in the country's largest auto plants because they bite fast, make clean quick holes and are extra tough for long and continuous service.

These heavy duty drills feature extra sturdy shanks, short flutes – with or without radial relief – and split points that help minimize operator fatigue. Then there's New York's special nitriding and homo-treating to add to their toughness. As with our standard drills, New York's body drills give you a saving of 25%.

All New York drills are made to last longer and give greater production. Holes are perfectly round, exactly on size without burrs, and you get more holes per drill. Perfect reasons for using New York drills on *your* assembly line – or wherever there's a difficult operation.

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TOOLS of today

model can be inclined in three different positions to accommodate various types of dies and to utilize gravity feed and discharge in automated production. The electrically controlled O.B.I. presses are available with either flywheel or geared drive.

The Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio. **Circle 319**

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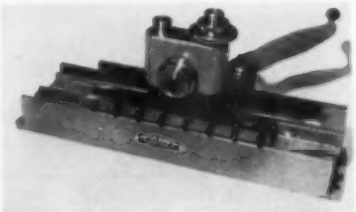
Marking Machine

Accurate graduation and marking of circular graduated machine tool dials, micrometer spindles and other cylindrical parts up to six inches in diameter

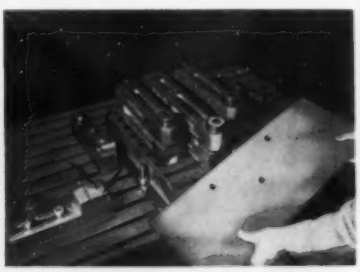


can be done with this unit. Tooling is inexpensive and make-ready is simple. Flat stencils are used.

Dayton Rogers Mfg. Co., 2824 13th Ave., S., Minneapolis 7, Minn. **Circle 320**

Magnetic Work Stops

Designed for universal mounting on templates, T-slotted plates and press brake bed rails in combination with Series A or B Unipunch hole punching and notching units, magnetic work



stops insure accurate gaging by eliminating bounce-back as the workpiece hits the gage. Magnetic attraction holds the workpiece against the stop. The stops can be used with dies up to 3½ inches high.

Punch Products Corp., 370 Babcock St., Buffalo 6, N. Y. **Circle 321**

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DISPOSABLE CARBIDE SCREW-TIP BORING BAR

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CRAFTS

Now you can cut deep, small bores fast, accurately — *and at less cost.* Precision made, Crafts New Boring Bar #1018 has a solid Carbide Shank — 3 times as rigid as steel — designed for holes ¼" diameter and up. Bore to "tenths" and hold the size. The inexpensive Carbide Tipped Screw-Tip is easily replaced — can be either discarded or resharpened if preferred. Also available — ½" O. D. Sleeve Adapter, for use in Jig Borers. For specifications and prices write to:

ARTHUR A. CRAFTS CO., INC.
603 NEWBURY STREET
BOSTON 15, MASS.

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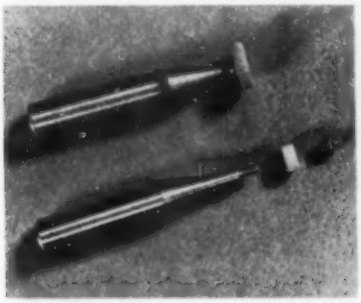
Microminiature Wheels

Microminiature grinding operations can be speeded economically by use of grinding wheels with dimensions of 0.085-inch diam, 0.036-inch thickness and 0.034-inch hole size. Illustrated



below the mounted point type of grinding wheel, which it replaces, the new wheel provides cost reduction of 75 percent since only the wheel need be replaced. Production cost is additionally lowered since wheel replacement does not affect tool alignment. The wheels operate at speeds up to 40,000 rpm.

Bay State Abrasive Products Co., 15 Union St., Westboro, Mass. **Circle 322**

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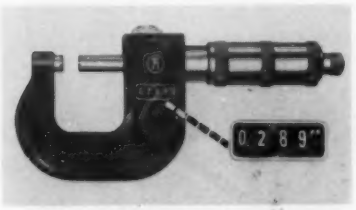
Direct Reading Micrometer

Dial readings from zero to one inch are instantly shown when this micrometer is set. The instrument is fitted with a friction stop and lock screw.

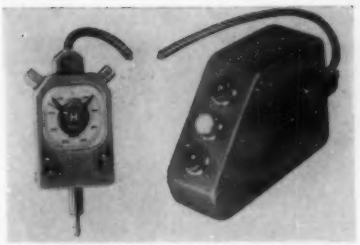


Measuring faces are made of tungsten and carbide. A wooden storage case is provided with each micrometer and accessory stands for desk or bench are available.

Kromedge Distributing Co., Inc., 863 65th St., Brooklyn 20, N. Y. **Circle 323**

Electric Indicator

Out-of-tolerance conditions are electrically signaled on the light box (right) when this gage is used for dimension measurement. The signal can



be used to turn on lights or for automatic control. If an adapter is added, the light box can be converted to a summarizing box for up to six electric indicators for gaging multiple dimensions. With this arrangement, an out-of-tolerance condition will be signaled by an "over" and/or "under" light. A "good" light will signal if all dimensions are within tolerance.

Hamilton Watch Co., Lancaster, Pa. **Circle 324**

Pneumatic Grinders

Small wheel pneumatic grinders are adjustable to any of 10 speeds between 16,000 and 25,000 rpm, permitting operation at the optimum tool speed for

Heavy Duty Vertical Milling Attachment

Heavy Duty Offset Vertical Milling Attachment

Universal Milling Attachment

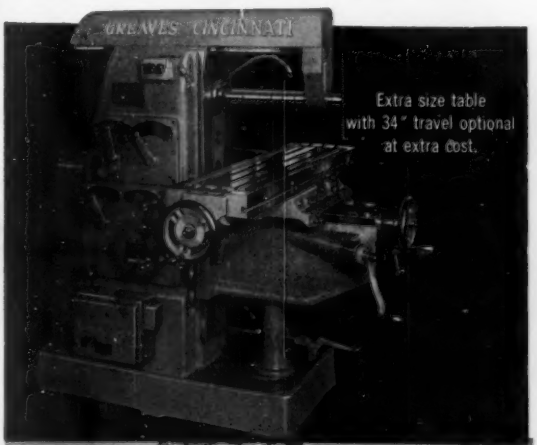
Toolmakers Overarm

Heavy duty attachments increase versatility of dependable, low-cost

GREAVES MILLS

"THE MOST MILL FOR THE LEAST MONEY"

A full line of attachments and accessories offer outstanding flexibility for all types of milling operations . . . with GREAVES MILLS. Make your own comparison of 22 specifications of Greaves and 7 other leading milling machines.



Extra size table with 34" travel optional at extra cost.

Send coupon for FREE Comparison Chart and detailed descriptive literature on easy-to-use attachments.

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2303 Eastern Avenue, Cincinnati 2, Ohio

Send Comparison Chart. I will make my own comparison of GREAVES MILLS with other makes.
Send information on Attachments and Accessories for GREAVES MILLS.

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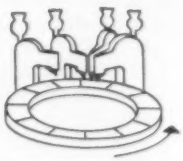
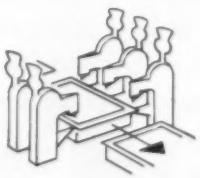
A FEW OF MANY POSSIBLE RIVETING HEAD POSITIONS THAT CAN BE USED

Rotating fixture showing suggested arrangement of riveting heads.

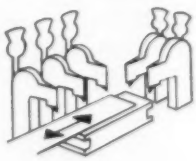


Riveting heads can be positioned for fastening on flat or curved assemblies.

Conveyor Belt permits multiple setting on both sides of an assembly.



Sliding fixture used for riveting 2 sides of an assembly.



AUTOMATE RIVET SETTING

for new low costs

For years assemblies made of metal and non-metal or a combination of both have been fastened most economically with semi-tubular rivets. And now even lower costs are possible with the thin-nose riveting heads designed by Chicago Rivet. These heads, pneumatically operated but electronically controlled, can be grouped in clusters on one or more planes and will set rivets as close as $^{13}/_{16}$" apart. Automation, thru rotating sliding or continuous belt feeding and riveting stations, is possible. Riveting heads may be repositioned and used again on new assemblies.

CUSHIONED RIVETING REDUCES BREAKAGE

A pneumatic riveter upsets the rivet with a squeezing action which minimizes breakage and automatically compensates for slight variation in assembly thicknesses.

The suggestions of Chicago Rivet fastening specialists will prove most helpful. Call them—no obligation.

AIR-POWERED RIVETING CATALOG contains description and specifications of 8 single and multiple riveters—also rivet setters designed for automation.

RIVET CATALOG describes 1388 standard tubular and split rivets and 25 single and multiple motorized automatic rivet setters.

Chicago Rivet & MACHINE CO.

960 So. 25th Ave., Bellwood, Ill. (Chicago Suburb) • Branch Factory: Tyrone, Pa.

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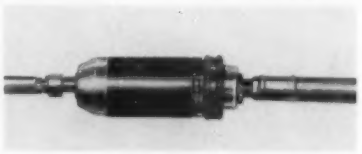
each different workpiece material, including plastics, aluminum and other nonferrous metals, steels of different hardnesses and stainless steels. Operating speed is set by rotation of a calibrated ring throttle speed regulator.



The Series 921 grinders are designed for driving small grinding wheels, rotary files, carbide burrs, routers, and sanding or cutting disks. The units are also available in single speed models with lever or pushbutton throttle control.

Thomas C. Wilson, Inc., 21-11 44th Ave., Long Island City 1, N. Y. **Circle 325**

Ultrasonic Materials Tester

Model CM100 ultrasonic materials tester is used for nondestructive inspection of material such as metals, plastics and ceramics, which can support ultrasonic waves. Uses include either surface or internal flaw detection, thickness measurement from one side and determination of physical and structural

properties. Components of the portable unit are a generator and receiver for high frequency vibrations that are sent in a pulsed beam through material to be inspected and discontinuities, as well as the opposite end, and reflect vibrations back to the receiver. Size and location of reflecting areas are reflected on the viewing screen. Accessories for a wide range of applications are available.

Circo Ultrasonic Corp., 51 Terminal Ave., Clark, N. J. **Circle 326**

on the spot

A FAST, ACCURATE GAGE—WHERE AND WHEN YOU NEED IT!

The MICROtrol® 170 is a transistorized gaging system for use at the machine, in the gage laboratory or on the production line. Production personnel find it simple to use. The four types of gage heads available can be used with the battery-powered amplifier.

Features

- *Only 2 control knobs*
- *One adjustment zeros both scales*
- *Large meter with 4.6" scale*
- *Dual range—from either ± .0003" to ± .003" or ± .001" to ± .010"*
- *Accurate—transistorized throughout*
- *Pocket-sized—5¾" square by 3⅛"*
- *Mounting adapters and gage head stored in cover*
- *Carrying case handle doubles as amplifier stand*
- *Lightweight—weighs only 3 lbs.*
- *Battery powered—can be used anywhere*
- *AA dry cells can be used in emergency*

Basic Gages start at $341.00

Contact your nearest Cutler-Hammer office or—Order Direct from

AIRBORNE INSTRUMENTS LABORATORY
DEER PARK, LONG ISLAND, NEW YORK
A DIVISION OF CUTLER-HAMMER, INC.

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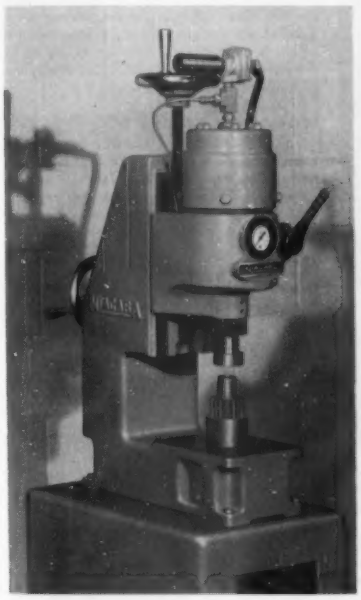
Single-Acting Air Presses

Twenty-eight models in a line of single-acting air presses are designed for punching, swaging, staking, upsetting and imprinting operations and for the seating and removal of close-tolerance bearings and bushings. Four press



sizes range in capacity from ½ to 2 tons at 85 psi, with a choice of three air and three electrical control systems. Accessories for specialized applications are available. All models can be bench mounted or furnished with a floor stand.

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y. **Circle 327**

USE READER SERVICE CARD ON PAGE 131 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Epoxy Resin Adhesive

Structural adhesive EC-1595 permits easy application techniques and provides unlimited working life for bonding high volume metal and structural assemblies. The high-strength, one-component substance contains a latent hardener that eliminates weighing and mixing a hardener with the base resin at time of use, and will not harden before curing operations are performed. In metal-to-metal bonds the adhesive provides shear strengths of 2500 psi at 75 F. High strength is maintained over a service temperature range of −67 F to +300 F. The adhesive has high creep resistance under constant stress, exceptional adhesion to metals and plastics, and excellent resistance to water, 20 percent salt spray, hydraulic oil and aromatic fuel. Contact pressure is suf-

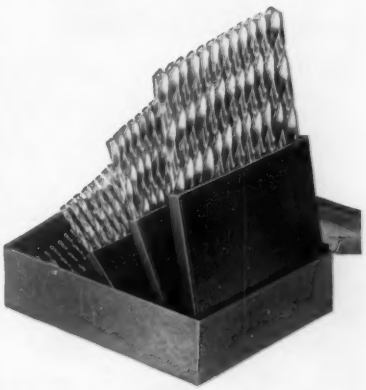
Hardened, Tempered and Ground-from-the-Solid!

It pays to specify

ACE

DRILLS
REAMERS
BLANKS

Premium Quality High Speed Steel, Solid Carbide and Carbide Tipped.



ACE DRILL SETS
Standard stock sets include Fractional, Wire and Letter size drills, packaged in convenient folding index cases.

ACE BLANK SETS
Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits available in standard Fractional, Wire and Letter series sets.

Call your local distributor today—or write Ace direct for latest catalog and price information.

ACE DRILL
Adrian, Michigan
ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

Use Reader Service Card, CIRCLE 50

Protection for Man and Machine

FUTURMILL'S "Way-Life" WAY COVERS

Way-Life covers are lightweight—yet very strong. The extruded aluminum sections are ribbed full length with a full length ball and socket type interlocking hinge.

SAVE THE WAYS—"Way-Life" covers keep chips, grit, dirt and other foreign matter out of the ways and feed mechanisms. The solid aluminum, interlocking sections will absorb a considerable amount of shock and prevent damage to the ways—such as caused by accidental dropping of heavy objects on the ways.

WORK WITH SAFETY—The strength and rigidity of "Way-Life" covers permit operators to walk safely on top of the cover, making machine servicing and job set-up safer and easier. It is impossible for personnel to fall through the cover or become caught or trapped between the ways.

CUT COST & MAINTENANCE—Unlike fabric, rubber, plastic, sheet metal, foil, telescopic, or accordion type covers, "Way-Life" covers will not burn, warp, tear, rust or buckle. They require no auxiliary power since the cover is motivated by table or column movement. No special servicing is necessary.

DRESS UP YOUR SHOP—"Way-Life" covers are *full dress—armored protection* for any machine . . . a complement of utility—economy and cleanliness for any shop.

Write: **FUTURMILL, Inc.** 6360 Highland Road Pontiac, Michigan

Use Reader Service Card, CIRCLE 51

2 NEW MONEY SAVING IDEAS!

the productivity of PowRarm, the flexibility of ERECT-YOUR-OWN!

ERECT-YOUR-OWN COMPONENTS...

Complete Kit No. 391 includes two 18" perforated aluminum strips, ¼" thick, three 90° connecting angles, two toggle clamps, 12 screws and nuts. Each part may also be ordered individually.

ERECT-YOUR-OWN *work holders*

NEW FROM WILTON... a versatile work holder that's perfect for light production and assembly. Quickly and easily changed for different jobs—a screwdriver is all that's needed. May be put together in any size or shape by production line operators. Use with Wilton PowRarm or bolt to bench.

Attach This Ad To Your Letterhead And Mail For Free Literature!

WILTON TK-80

WILTON TOOL MANUFACTURING CO., INC., SCHILLER PARK, ILLINOIS

SOLD BY LEADING DISTRIBUTORS THE WORLD OVER

Use Reader Service Card, CIRCLE 52

ficient during curing operations. Optimum cure time, which can be decreased by increase of cure temperatures, is 60 min at 600 F.

Adhesives, Coatings and Sealers Div., Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. **Circle 328**

Numerically Controlled Diesinking Machine

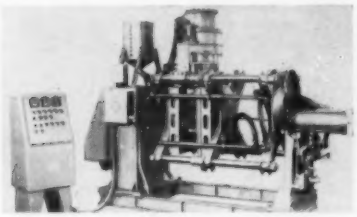
Continuous automatic milling of regular or irregular shapes in three dimensions, under numerical control, is accomplished by this machine. Horizontal and transverse motion of the table, the vertical motion of the cutter spindle and the feed rates are automatically controlled by coded punched

tape. The operator loads the workpiece, starts the tape by pushbutton, changes tools as required and sets the spindle speeds. The machine is designed for both short and long-run production, particularly in tool and die operations. Eighteen spindle speeds range from 40 to 3600 rpm. Table travel is 36 inches longitudinally and 12 inches transversely. Vertical slide travel is 22 inches. Table working surface is 48 x 30 inches. The unit eliminates the needs for templates, models or fixtures, providing savings in tooling and production lead time costs.

Pratt & Whitney Co., Inc., West Hartford 1, Conn. **Circle 329**

Shell Core Machine

Model SC-100, with 100-lb blow capacity, can mass-produce either large shell cores in single cavity boxes or a wide range of medium-size cores in multicavity boxes. All operations except removal of finished cores are automatic. The machine has gravity sand feed; integral direct-acting springless stripping mechanism; timer-controlled, independently adjustable blow, dwell, drainout and cure cycles; gas-fired, thermostatically-controlled ovens that provide accurate temperatures for both contour and solid-back



core boxes; and simplified core box mounting. The unit's platens accommodate core boxes up to 24 x 30 x 14 inches. The machine is illustrated in the blow position.

SPO Inc., 6428 Grand Division Ave., Cleveland 25, Ohio. **Circle 330**

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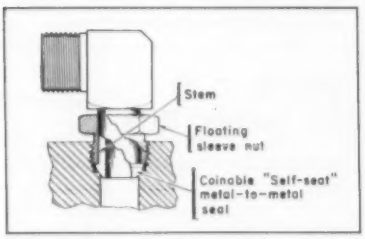
Versatile Hydraulic Fitting

Easily assembled with standard inexpensive tooling, this fitting provides a leakproof metal-to-metal "self-seat" seal independent of the threads. Elbows and toes have swivel features.

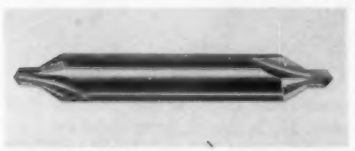


The fittings can be placed at close centers, eliminating the necessity for staggering and allowing alignment with the tube run. The seal remains leakproof throughout repeated assemblies. Fittings are available in sizes of from ⅛ to 2 inches.

Flodar Corp., 16911 St. Clair Ave., Cleveland 10, Ohio. **Circle 331**

Center Drill, Countersink

Designed to cut extremely hard, highly abrasive materials, this solid carbide combined center drill and countersink has a double end, 60-degree



included angle and right-hand cutting. In addition to the manufacturer's 710-A series, the tool is available in six sizes ranging from ⅛ to ½ inch.

Dixie Tool Industries, Inc., Bridgeport, Mich. **Circle 332**

JARVIS UNVEILS A REVOLUTIONARY DESIGN IN COLD FORMING TAPS!

NEW JAR-FLO

LUBE-GRUV® TAPS

LUBRICATION GROOVES MAKE CHIPLESS FORMING OF INTERNAL THREADS AS EASY AS CONVENTIONAL TAPPING!

NOW, for the first time, cold forming taps that give *full time lubrication* to the *forming contact* area during the *full* tapping cycle.

LUBE-GRUV® gives you a *far superior finish* on the formed threads than is possible with conventional cold forming taps.

USE CONVENTIONAL TAPPING EQUIPMENT. The combination of *positive lubrication* and *narrow contact* surface makes the forming of internal threads much easier than with ordinary cold forming taps. Jar-Flo with LUBE-GRUV has less drag, requires less driving torque.

LUBE-GRUV® Jar-Flo TAPS FOR CHIPLESS FORMING INTERNAL THREADS IN DUCTILE MATERIALS—STRONGER THREADS—NO CHIPS—AVAILABLE IN PLUG OR BOTTOMING TYPES

SEND FOR COMPLETE DETAILS

Jarvis CORPORATION

JARVIS CORPORATION, 100 Washington Park North Attleboro, Mass.

___Have Rep. call ___Rush LUBE-GRUV Brochure

Name _____ Title _____

Company _____

Street _____

City & State _____

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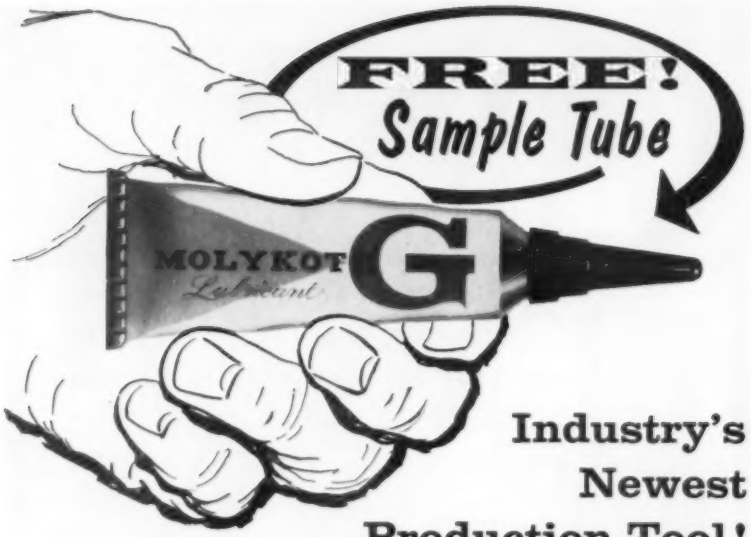
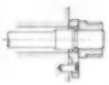


Industry's Newest Production Tool!

MOLYKOTE® G
LUBRICANT

Try it ...ON ANY OF THESE APPLICATIONS AND PROVE ITS LUBRICATING ABILITY!

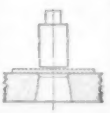


THREADED CONNECTIONS
No galling or seizing. Specified torque produces uniform tension.

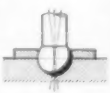
COLLET CHUCKS
Trouble-free opening and closing. No sticking.

SPLINED SHAFTS & HEAVILY LOADED GEARS
Reduces fretting and wear. Also used for wearing in heavily loaded gears.

PRESS FITTING
Prevents galling, seizing, metal pick-up and distortion.



METAL FORMING
Makes difficult jobs easy and increases die life. Effective on punching and stamping tools.



SPHERICAL SEATS
Effective on spherical seats, rod end bearings, universal joints or wherever reciprocating motion exists.

POWER SCREWS
No galling or seizing.

Send for your FREE SAMPLE of MOLYKOTE G LUBRICANT today. We will also send a copy of our new Bulletin 126B-1 with complete details.

THE ALPHA-MOLYKOTE CORP.
65 Harvard Ave., Stamford, Conn.
Please send me a free sample of your MOLYKOTE G Lubricant.

NAME.....
TITLE.....
COMPANY.....
ADDRESS.....
CITY..... ZONE..... STATE.....

MOLYKOTE G *Lubricant*
Industry's Newest Production Tool
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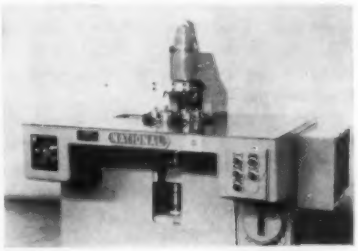
TOOLS of today

Transistor Welder

Convertible from single point to dial feed, this machine has an integral 3 x 4-ft table designed to accommodate a standard dry box. The transformer is



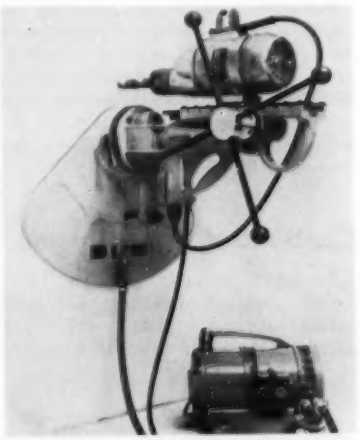
mounted in the unit's base. An operator hand-loading a six-station dial can produce 2000 transistors an hour.

National Electric Welding Machines Co., 1846 Trumbull St., Bay City, Mich. **Circle 333**

USE READER SERVICE CARD ON PAGE 131 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Portable Drill Has Suction Base

Use of a vacuum base that is, in effect, a giant suction cup gives a portable drill the stability needed for controlled drillings, even in horizontal use. A flexible neoprene seal is built



around the edge of the base so that, when air is drawn from the base by a vacuum pump, the unit is held securely against the wall, even on irregular or uneven surfaces. A Bell & Gossett high-volume dry vacuum pump gives 3000 lb of holding force.

Bux Magnetic Products, Inc., 1355 N. 10th St., San Jose, Calif. **Circle 334**

Trade Literature

for free booklets and catalogs—use request card, page 131

REPRINTS of a technical paper by A. L. Hodge discuss "Predicting Effects of Oxygen, Moisture and Fuel Additions on Blast Furnace Operation with Electronic Computers." Linde Co., Div. of Union Carbide **(Circle 401)** . . . "Toolease—A Powerful New Profit Tool for Your Key Men," describes a machine tool leasing plan. The American Tool Works Co. **(Circle 402)** . . . Eight-page bulletin 500-P4 describes "Rotoforming." Commercial Shearing & Stamping Co. **(Circle 403)** . . . Standard slide assemblies are discussed in a 24-page manual. Russel T. Gilman, Inc. **(Circle 404)** . . . Bulletin AD-150 describes a line of seals, their applications and engineering specifications. Garlock, Inc. **(Circle 405)**

Adhesives

Information on adhesives and their advantages for joining parts are presented in a product designers bulletin. B. B. Chemical Co. **(Circle 406)**

Bending

Bulletin 260 discusses "Bending Conduit or Pipe Easily and Accurately." Lidseen of North Carolina, Inc. **(Circle 407)**

Boring, Drilling, Tapping & Threading

Twenty-inch power feed drill presses are described in 12-page bulletin 100M. Rockwell Mfg. Co. **(Circle 408)** . . . "The Ten Musts of A Jig Borer" are detailed in a four-page check list that includes photographs and drawings. Moore Special Tool Co. **(Circle 409)** . . . Offset boring heads, interchangeable for use on jig borers, boring mills or turret lathes, are described in an eight-page, illustrated bulletin. Everede Tool Co. **(Circle 410)**

Casting

Resin-coated curing sand for producing shell cores and molds is described in a six-page folder. Faskure Coated Sand Div., Aurora Metal Co. **(Circle 411)** . . . A four-page brochure presents a new shell investment casting technique. Engineered Precision Casting Co. **(Circle 412)** . . . Mold release oils for zinc and aluminum die casting are described in a technical bulletin. Sun Oil Co. **(Circle 413)**

Cutting Tools & Holders

Carbide circular cutoff tools for Brown & Sharpe automatic screw machine are listed in a catalog supplement. Somma Tool Co., Inc. **(Circle 414)**

Diamond Tools

Catalog No. 460 contains 36 illustrated pages of information on 232 standard diamond tools. The Staset Co. **(Circle 415)** . . . Industrial research and development activities of the organization are reported in a 24-page, illustrated brochure. The Diamond Research Laboratory. **(Circle 416)**

Electric Motors, Controls & Drives

Complete motor and generator lines information is available in an eight-page reference brochure, "Motor Selector." Howell Electric Motors Co. **(Circle 417)** . . . Application studies of a step-function speed reductor are described in data sheet No. 1, bulletin 262. Insco Co., Div. of Barry Controls Inc. **(Circle 418)** . . . Characteristics of a line of magnetic particle clutches are listed in an illustrated, 16-page catalog. Lear, Inc. **(Circle 419)**

Fasteners & Fastening

Industrial pliers for application and removal of retaining rings are discussed in a four-page catalog. Industrial Retaining Ring Co. **(Circle 420)** . . . Bulletin 773 gives specifications for a line of socket cap screws. The Bristol Co. **(Circle 421)**

Finishing & Grinding

Technical bulletin No. 900 presents a natural mineral barrel finishing medium in text and photographs, contains a table of 16 screen mesh sizes and illustrates case histories of results achieved in commerical processing. Lord Chemical Corp. **(Circle 422)** . . . "This Is SND" is a 20-page booklet describing both treated and untreated selected natural diamond grit. Industrial Diamond Div., Engelhard Hanovia, Inc. **(Circle 423)** . . . Bulletin AD-1224 describes and illustrates a combination machine for custom or production finishing. Delta Power Tool Div., Rockwell Mfg. Co. **(Circle 424)**

Fluid Power

Bulletin 203 is an eight-page presentation on the use of a line of axial piston pumps at pressures up to 5000 psi. Dennison Engineering Div., American Brake Shoe Co. **(Circle 425)** . . . A series of data sheets detail a low-pressure hydraulic cartridge relief valve and its applications. Fluid Regulators Corp. **(Circle 426)** . . . Manual or electrically operated and remotely controlled pressure regulators are covered in a 12-page folder. Marotta Valve Corp. **(Circle 427)**

Gears & Gearmaking

Bulletin No. 100 is a 12-page report on "Full Tooth Contour Induction Hardening of large Gears." Philadelphia Gear Corp. **(Circle 428)**

Heat-Treating & Chilling

Thirty-two models in a line of elevator furnaces equipped with neoprene-sealed retorts are presented in bulletin EF-260. Harper Electric Furnace Co. **(Circle 429)**

Indexing

Design, application and principal operating features of series MD double tool plate indexing machine chassis are covered in a two-page bulletin. Swanson-Erie Corp. **(Circle 430)**

Inspection & Measurement

Hole locating and concentricity gages are shown in an eight-page bulletin. Mayes Tool Co. **(Circle 431)** . . . A portable height gage and its accessories are described in an illustrated brochure. United States Milling Co. **(Circle 432)**

Trade Literature

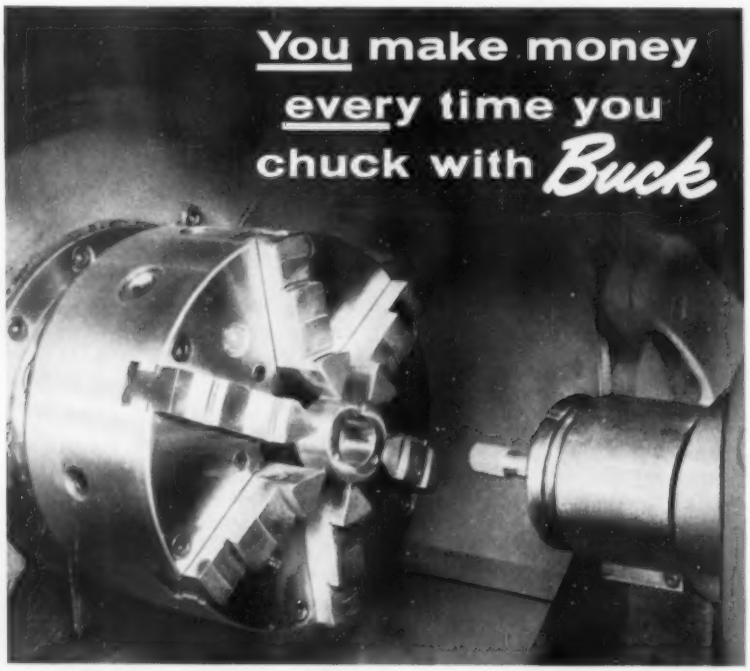
Lathes

Design features, engineering specifications and illustrations provide information of the P & J 3E-15 automatic lathe in a 12-page publication. Pratt & Whitney Co., Inc. **(Circle 432)** . . . Bulletin 212 describes the Model HD 2013 heavy duty engine lathe. Neble Machine Tool Corp. **(Circle 433)** . . . Four-page bulletin 1226 covers the Model E high-speed, semiautomatic, single-point threading lathe. Gisholt Machine Co. **(Circle 434)**

Metals

Reference chart for 1960 contains 55 of the more widely used cast alloys in the carbon, low alloy and stainless groups and also nickle and monel, with standard data and a section for design applications for each alloy. Lebanon Steel Foundry **(Circle 435)** . . . Extruded special aluminum bronze rectangles for severe wear and abrasion applications are described in revised bulletin G-50a. Ampco Metal, Inc. **(Circle 436)** . . . Complete properties of tungsten, tantalum, molybdenum and columbium are described in a refractory metal chart that also contains temperature conversion data. Fansteel Metallurgical Corp. **(Circle 437)** . . . Four-page technical bulletin contains a quick reference weight chart for square and rectangular welded steel tubing. The Standard Tube Co. **(Circle 438)** . . . Manufacturing and testing of stainless, full finish, rock-forged pipe and tubing and stainless full finish pipe and tubing is described in a four-page brochure. Swepco Tube Corp. **(Circle 439)** . . . Short-time tensile data on alloy No. 7130, revised to conform to the latest available information, is presented in an eight-page booklet. Haynes Stellite Co. **(Circle 440)** . . . A 29-page brochure presents comprehensive information on designing for alloy preforms. Lucas-Milhaupt Engineering Co. **(Circle 441)** . . . Role of aluminum extrusions in peacetime atomic research is described in bulletin No. 14. Precision Extrusions, Inc. **(Circle 442)**

Only a rich man can afford old-style chucks!



Buck gives you this.....

Dead true precision.... .0005" precision chucking duplicate parts... ends need for collets ... holds O.D. and I.D. true... takes up wear... compensates for spindle run-out...and there's NO PRICE PREMIUM!

If you haven't yet put Buck Ajust-Tru® chucks to work in your plant there are big and profitable performance surprises ahead. Send for complete information. "It pays to chuck with Buck."

Makers of Scroll, Power, Dust Proof, Independent Chucks.

BUCK TOOL COMPANY

833 SCHIPPERS LANE • KALAMAZOO, MICHIGAN

Use Reader Service Card, CIRCLE 55

Milling

New milling cutters and an expanded line of end mills are introduced and described in an illustrated, 64-page book. The Cleveland Twist Drill Co. **(Circle 443)** . . . Four separate cutting tool catalogs, totaling 138 pages, are combined in an expandable binder. Cutting Tool Div., Brown & Sharpe Mfg. Co. **(Circle 444)**

Numerical Control

Facilities for control media preparation service that includes parts programming, computing, tape processing, tool design, tool fabrication and parts fabrication, are described in detail in a 50-page book. Boeing Applied Computing Services. **(Circle 445)**

Plating & Painting

Special coatings available for application on plastics, metals, glass and wood are listed in "Coatings Selector" charts that can be mounted for easy reference. Bee Chemical Co. **(Circle 446)**

Pressworking

Open-back, inclinable presses of from 7 to 125-ton capacities are described and illustrated in a 20-page catalog. Federal Press Co. **(Circle 447)** . . . Bulletin 6000 contains 16 pages that detail the company's complete line of press equipment. The Hydraulic Press Mfg. Co. **(Circle 448)**

Punches & Dies

Four-page bulletin, "The Punch Line," features a pull-pin punch and illustrates other punches in a line. The Producto Machine Co. **(Circle 449)** . . . Report

No. 600 provides the performance record of the longest one-piece blanking punch ever produced by the manufacturer. Kennametal Inc. **(Circle 450)**

Sawing

A 36-page handbook, "Sawology," provides a guide to the selection and use of hacksaw and band saw blades for industrial use. Nicholson File Co. **(Circle 451)** . . . Four new power saws are described and illustrated in a 12-page color catalog. The DoAll Co. **(Circle 452)**

Switches, Relays & Solenoids

Bulletin GEA-7021 discusses the company's complete line of relays for all applications. General Electric Co. **(Circle 453)** . . . Bulletin 94E describes a line of force control switches that operate in compression or tension and that can trigger as many as four separate operations. W. C. Dillon & Co., Inc. **(Circle 454)**

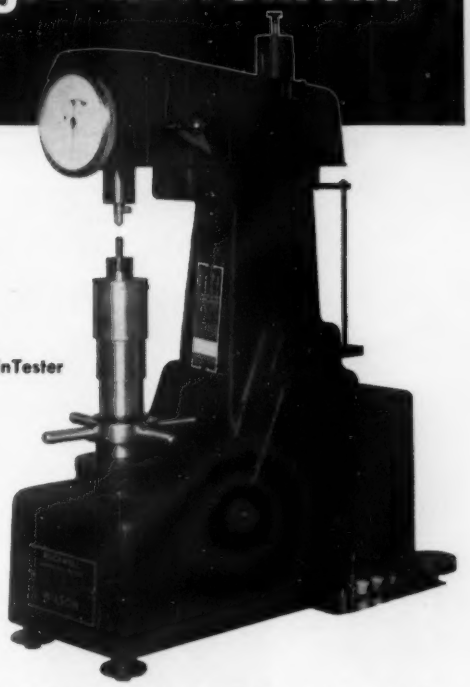
Welding

"Vest Pocket Guide to Better Welds" contains 80 pages of arc welding information. Hobart Brothers Co. **(Circle 455)** . . . Sixteen-page instruction manual describes the operation and use of the carbon arc welding process. Arcair Co. **(Circle 456)** . . . Improvement of product quality and lowering of production costs on resistance welding jobs with the spike power electronic control and power system is discussed in a four-page folder. Robotron Corp. **(Circle 457)** . . . Line of manual, semiautomatic and automatic equipment for tungsten-inert-gas welding process is covered in catalog ADC 709G. Air Reduction Sales Co. Div., Air Reduction Co., Inc. **(Circle 458)** . . . "The Alcoa Filler Metal Selection Chart" makes filler alloy choices possible based on parent metal combinations and common service requirements demanded of welded assemblies. Aluminum Company of America **(Circle 459)** . . . Gas-shielded metal-arc welding equipment, both manual and automatic, is covered in catalog ADC 717F. Air Reduction Sales Co. Div., Air Reduction Co., Inc. **(Circle 460)** . . . Four-page bulletin GED-3881 describes features and advantages of ribbon or silicon carbide resistor mesh-belt furnaces for copper brazing, silver brazing, sintering and bright annealing. General Electric Co. **(Circle 461)**

Workholding

A 16-page booklet contains condensed information and illustrations on a line of standard and custom clamps. Wittek Mfg. Co. **(Circle 462)**

Two Hardness Testers in a Single Instrument



Wilson "Rockwell" TwinTester

- The new Wilson Rockwell TwinTester combines in one instrument the functions of both a Rockwell and a Rockwell superficial hardness tester. Designed primarily for use in such areas as tool departments, maintenance repair shops and laboratories, the TwinTester offers many outstanding features.

Large direct-reading dial is marked with B and C scales for Rockwell hardness, and N and T scales for superficial Rockwell hardness readings. Just one zero set position for all scales.

Easy to operate, the TwinTester can be changed from Rockwell to Rockwell superficial testing in seconds.

Complete equipment includes cowl, ball penetrator for B and T scales, Rockwell test blocks, anvils, dust cover and protective sleeve set.

A complete line of Wilson Rockwell instruments is available, including semi and fully automatic models.

Wilson "Brale" Diamond Penetrators Each diamond is cut to an exact shape. A comparator check and microscopic inspection of each diamond assure perfect readings every time.

Write for details—Ask for Catalog RT-58. It gives complete information on the Superficial tester as well as on the full line of Wilson Rockwell hardness testers.

WILSON "ROCKWELL" HARDNESS TESTERS

ACCO

Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.
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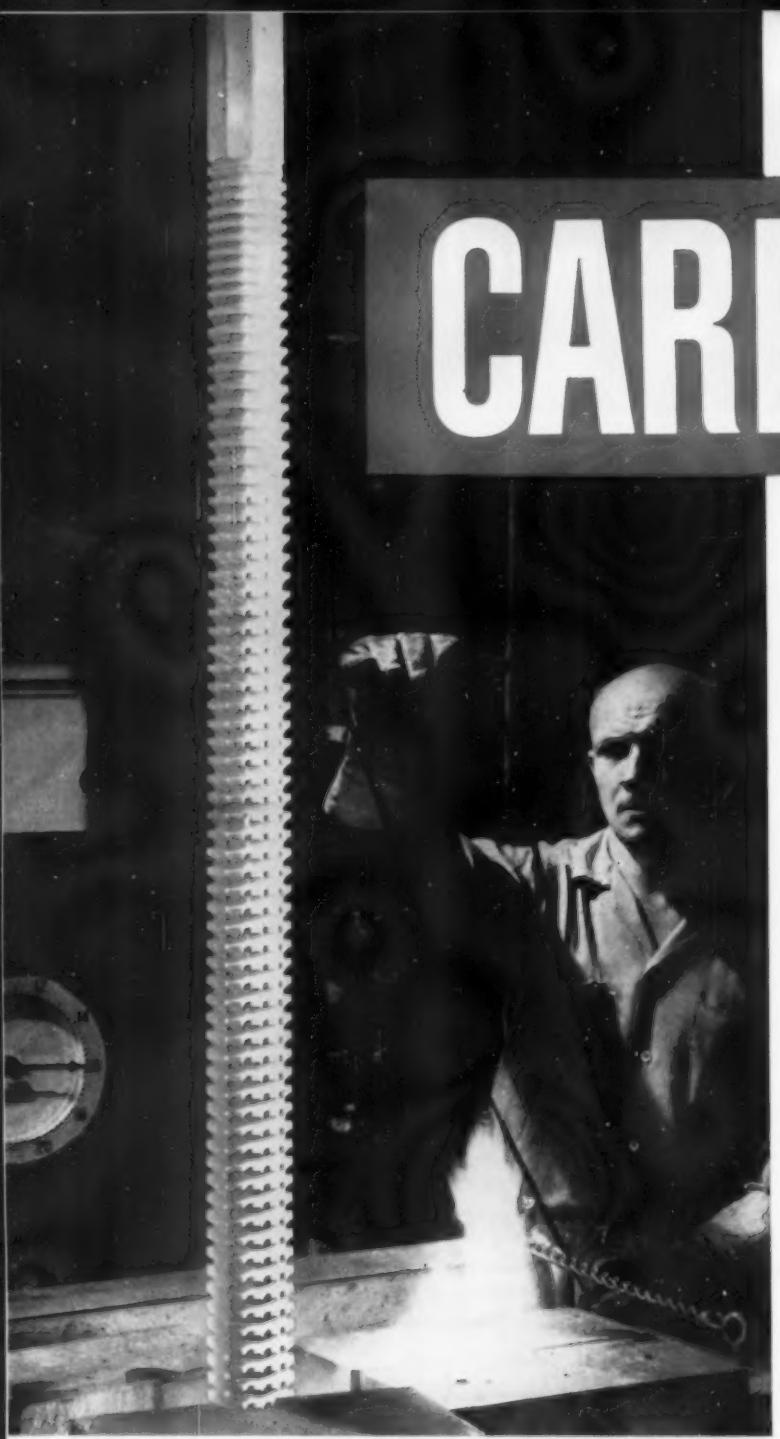

With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard and custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut downtime and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

59-14

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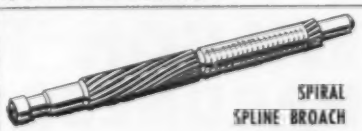
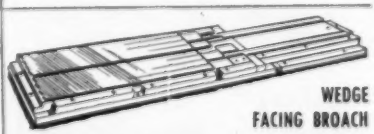
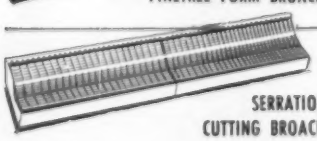
PINETREE FORM BROACH



SPIRAL SPLINE BROACH



WEDGE FACING BROACH



SERRATION CUTTING BROACH

INVOLUTE SPLINE SHELL-TYPE BROACH

CARBIDE-TIPPED BROACH SECTIONS

Charles R. Onsrud, left, is newly elected president of the Onsrud Machine Works, Inc., Niles, Ill. Other new officers announced by board chairman R. F. Onsrud are Miss Hjordis R. Krabol, vice president and treasurer; John M. Wilkin, secretary; and O. B. Anderson, assistant secretary. The company designs and manufactures a variety of metal and woodworking tools for industry.

Colin Sharp, right, formerly West Coast service manager for Brown & Sharpe Mfg. Co., has returned to the company's headquarters at Providence, R. I., to assume his new position as director of research and development laboratory of the Cutting Tool Div. Sharp will supervise the experimental laboratory and will also supervise special cutting tool applications and custom modifications.

Men at Work

Calvin Irish has been appointed manager of product engineering of the National Automatic Tool Co., Inc., Richmond, Ind. He was formerly assistant chief engineer of the Machinery Div., Ex-Cell-O Corp., Detroit, Mich., and had been associated with the company since 1937. In his new position, Irish replaces LeGrand Terry, who is retiring after 35 years of service with NATCO.

KARL F. KELLERMAN, former assistant to the vice president of engineering, has been appointed assistant to A. P. FONTAINE, executive vice president of the Bendix Corp.

The S-P Mfg. Corp., Solon, Ohio, has re-elected the following directors: H. LEE BASSETT, D. LEE BASSETT, CHARLES B. LANSING and RICHARD H. STEWART. MERRIT B. SAMPSON, director of engineering, has been elected to the office of vice president—engineering and RICHARD E. SUTHERLAND, sales manager and assistant to the executive vice president, has been elected to the office of vice president—sales.

HERBERT L. MISCH has been appointed chief engineer of the product and production engineering office of Metal Stamping Div., Ford Motor Co. He will replace H. C. GREBE who has been appointed chief engineering consultant to the division.

President Edwin F. Shelley of USI Robodyne has been appointed a group officer and vice president of U.S. Industries, Inc., the parent company. The post will give Shelley executive supervision over the company's Technical Center, Florida; the Western Design Div., California; and the Office of Government Programs, New York; in addition to the Robodyne Div., which he has headed since 1958.

THOMAS A. FRIBLEY has been elected president of the Cleveland Cap Screw Co., Cleveland, Ohio. He succeeds his father, the late JOSEPH W. FRIBLEY, president and founder of the company, who died in June. The company is a wholly owned subsidiary of Standard Pressed Steel Co., Jenkintown, Pa.

Appointment of ARTHUR KELLERMANN as manager of manufacturing of the Alemite and Instrument Div., Stewart-Warner Corp., has been announced. Plant superintendent since 1957, Kellermann began with the company in 1928 as an apprentice toolmaker. He filled a number of production supervisory and management positions prior to becoming assistant superintendent of the Alemite and Instrument Div. plants in 1950.

JOSEPH B. ELLIOTT has assumed the duties of president and general manager of the York Div. of Borg-Warner Corp.

Philip O. Geier, Jr. was recently elected vice president and appointed assistant general manager of the Cincinnati Milling Machine Co. He was formerly manager of the Products Div. and is succeeded in that post by Maurice Gormly, who has been with the company since 1951 and was director of the Grinding Wheel Laboratory and manager of the Grinding Wheel Plant.

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On Brown and Sharpe, and other automatics

INSERT CHASERS SAVE UP TO 33%

Insert chasers are like safety razor blades: they cost so little that you can throw them away when dull. Or, for utmost economy, you can resharpen them over and over again. Only a flash grind is required. For approximately $50 you get a dozen sets of ¾—16 insert chasers, each set ground ready to go. You will be amazed at the quantity of threads they will cut, even to Class 3 specifications, with a minimum of downtime. FREE: "Unified and American Screw Thread Digest".

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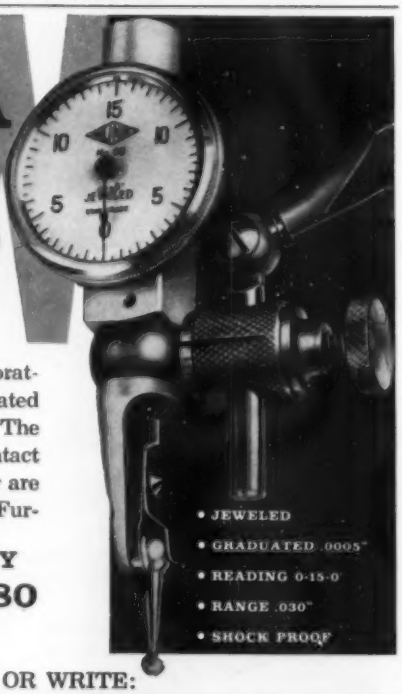

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ENGINEERING BOOKSHELF

PRODUCTION CONTROL—*By Niles V. Reinfeld. Published by Prentice Hall, Inc., 70 Fifth Ave., New York 11, N. Y. Price, $8. 339 pages.*

Production-control departments in modern manufacturing plants are the inevitable byproducts of changed marketing concepts in modern industry. Fifty years ago the abiding philosophy of industry was to sell what it made. Today it makes what it sells and the role of production control is essentially that of an arbiter between sales and marketing divisions. As such, it is frequently and impartially castigated by both divisions while serving as a whipping boy to top management. Nonetheless, the necessity of this department has been recognized and in modern plants production-control men are at staff level.

This book defines the functions of production control insofar as definitions are possible. Tracing administrative lines as they cross in this department, it also deals with the relationship between production control and tool engineering. Because tool control functions have an effect on production processes—and therefore on deliveries—tool engineers are inextricably linked to production-control department. In many cases they run them.

Starting with basic concepts evolved by Frederick Taylor (which are still good, although dated), the book concludes with the psychology of management. Because production control seems destined to become an even more important aspect of management as technology advances, tool and manufacturing engineers should have some knowledge of its mechanics. This book is an excellent primer.

CEMENTED CARBIDES—*By Dr. Paul Schwarzkopf and Dr. Richard Kieffer. Published by The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price $15. 349 pages.*

Technology, metallurgy and applications of cemented carbides are discussed in this book. This includes the historical development of the carbides, details of the sintering process and the principles of machining with cemented carbides. In addition, details

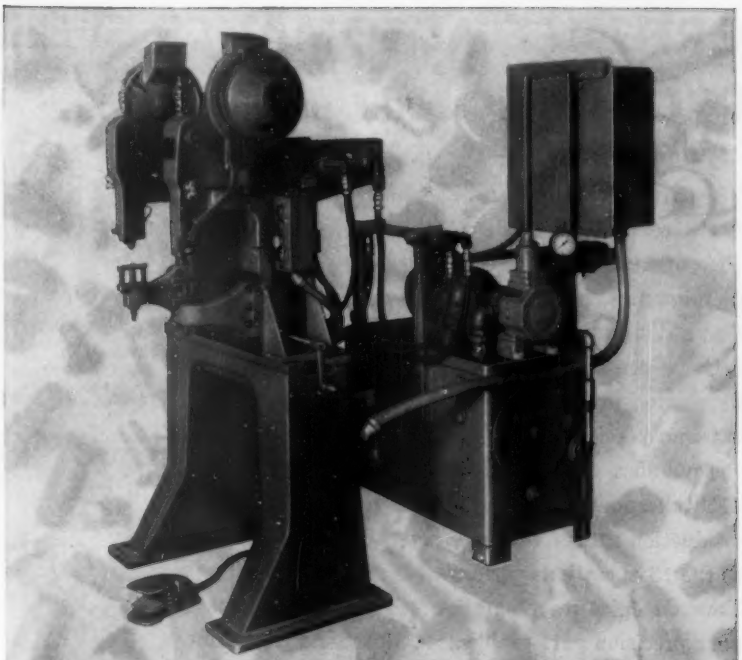
of carbide tool and die design for such widely separated fields as the coal-mining and wire-drawing industries are presented. By including detailed analyses of the chemical and metallurgical properties of the carbides, the authors have succeeded in writing a book useful to tool engineers as a text and as a reference.

HISTORY OF THE MILLING MACHINE—*By Robert S. Woodbury. Published by the Technology Press, Massachusetts Institute of Technology, Cambridge 39, Mass. Price $2.50. 107 pages.*

Third in the series of Technology Monographs to be published, Mr. Woodbury traces the evolution of milling machines from Eli Whitney's machine (circa 1820) the first miller ever built, to numerical controlled milling machines. Though invented about 140 years ago, Whitney's machine was equipped with gibs, a power feed and rigid box base. Continued developments brought about the Lincoln miller in 1855 from which bed type machines later developed, and Brown's universal miller in 1861, the epochmaking knee and column miller and parent of this type machine. Further refinements, the feed mechanisms, drives, cutters, vertical spindle machines, specials and automatics are presented clearly with ample detail. Fine illustrations and complete bibliography are provided. This well-bound paperback will contribute to any tool engineer's understanding of milling machines and the history of their development.

DIGITAL COMPUTER PRINCIPLES—*By Wayne C. Irwin. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. Price $8. 321 pages.*

Commencing with building blocks and logic elements, Irwin progresses from the simple and understandable to a comprehension of computer design, logic, function and programming. No particular background is needed as a prerequisite for using this book as it is written to present the computer art to persons with divergent backgrounds. Boolean Algebra, codes, logic, binary and other number systems (9 times 9 equals 51 in hexadecimal), Karnaugh maps, Venn diagrams, truth tables and the Harvard minimizing charts are explained. Not much discussion is given to details of electronic functioning of the various pieces of computer and logic hardware. Typical computer input-output equipment is described. Simple computer programming examples are developed in a clear and orderly fashion. This book will prove useful in preparing tool engineers for using computers and numerical control in manufacturing.



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Added recently to the versatile T-J line of unit and production line riveting and clinching machines is the new Hydraulic Dual Rivitor. The Model HDR will set two ¼″ solid steel rivets at once with adjustable spacing from 1½″ to 18″ maximum, center to center, being fed from 10″ hoppers. Operating cycle is approximately .8 second, at 420 P.S.I. oil pressure furnished from a hydraulic power unit with maximum of 1000 P.S.I. output. For complete specifications write to The Tomkins-Johnson Co., 2425 W. Michigan Ave., Jackson, Michigan for Bulletin HDR-4-59.

For information on other T-J Rivitors and Clinchors write for Bulletin No. 555.

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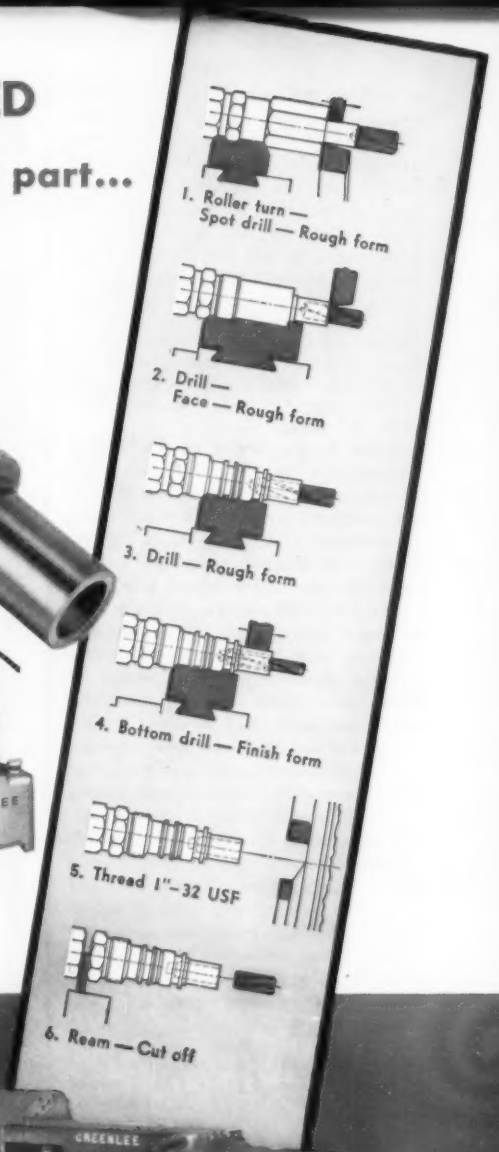
GREENLEE AUTOMATICS SPEED PRODUCTION of precision pump part...

The part is the injector cylinder of the Greenlee No. 798 High-Pressure Portable Power Pump manufactured by Greenlee Tool Co., a division of Greenlee Bros. & Co. Since the pump is capable of developing pressures up to 10,000 psi, extreme precision is required in producing the cylinder. It is machined from 1-inch hexagon 4150 chromium-molybdenum steel at a gross production rate of 48 pieces per hour. Sequence of the 13 operations performed is shown at right. Your Greenlee representative will be glad to help solve your precision part problems . . . just send us a print.


1. Roller turn — Spot drill — Rough form
2. Drill — Face — Rough form
3. Drill — Rough form
4. Bottom drill — Finish form
5. Thread 1"–32 USF
6. Ream — Cut off

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who's meeting and where

Aug. 15-17. ASME-AIChE. Heat Transfer conference and exhibit. Statler-Hilton Hotel, Buffalo, N. Y.

Aug. 22-26. Massachusetts Institute of Technology. Summer program, Engineering Aspects of the Solidification of Metals. M.I.T., Cambridge 39, Mass.

Aug. 28-Sept. 2. The Pennsylvania State University. Work Measurement seminar. Continuing Education Conference Center, University Park, Pa.

Sept. 6-16. NMTBA. Machine Tool Exposition. International Amphitheater, Chicago, Ill.

Sept. 6-16. Production Engineering Show. Navy Pier, Chicago, Ill. Information available from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

Sept. 7-9. ASME. Joint Automatic Control conference. M.I.T., Cambridge 39, Mass.

Sept. 7-15. Second Coliseum Machinery Show. Coliseum, Chicago, Ill.

Sept. 11-14. MHI. Joint industry fall meetings. The Cavalier Club. Virginia Beach, Va.

Sept. 11-20. European Machine Tool Show. Fairgrounds, Hanover, West Germany. Information available from the German American Chamber of Commerce, 666 Fifth Ave., New York 19, N. Y.

Sept. 14-15. Fourth annual military-industrial Electronic Test Equipment symposium. Museum of Science and Industry, Chicago 16, Ill. Information available from Robert Brausch, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

Sept. 15-16. ASME. Engineering Management conference. Morrison Hotel, Chicago, Ill.

Sept. 19-20. SFSA. Fall meeting. The Homestead, Hot Springs, Va.

Sept. 21-23. ASME-AIEE. Power conference. Bellevue-Stratford Hotel, Philadelphia, Pa.

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Only *genuine* Allens have Leader Points that make starting easier, and greatly minimize danger of cross threading. *Genuine* Allens are "pressur-formd" to preserve the long fibers uncut throughout the length of the screw, giving stronger sockets for greater tightening torque.

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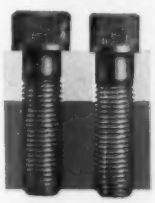
Allen's new 1960 Series Socket Head Cap Screws give up to 2¾ times more load carrying capacity, without indentation.



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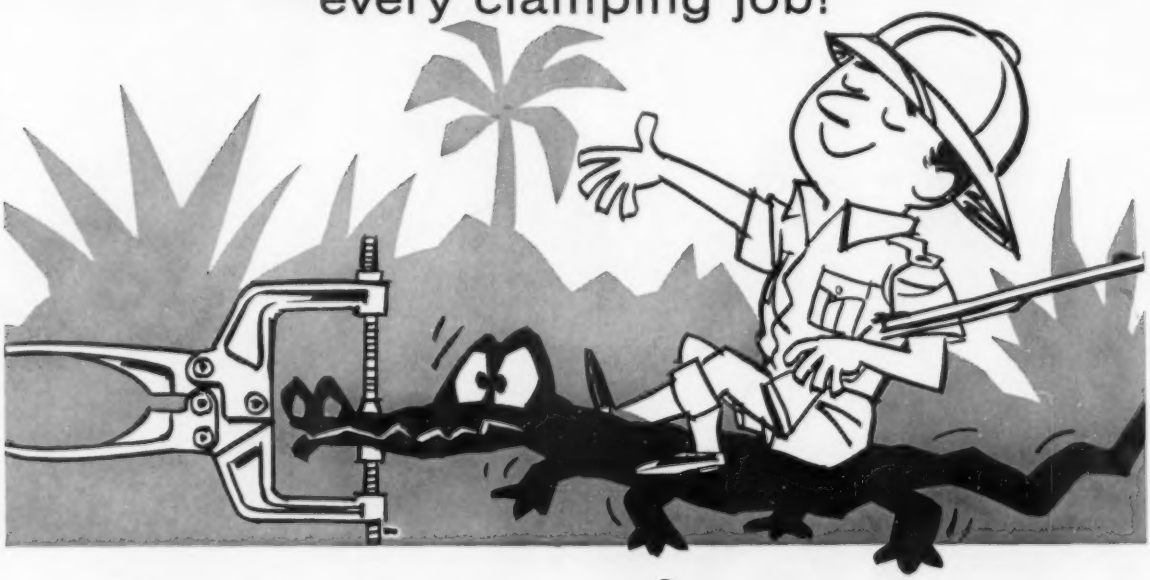

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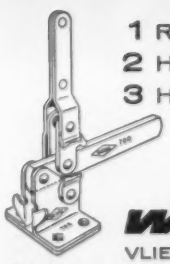

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Sheet-Grinding Process

Engineers at National Electric Welding Machines Co. and Inland Steel Container Co. have developed a process for automatic grinding of edges on flat sheets. Edge grinding is performed as a preparatory operation for resistance seam welding. Used on an automatic container line, the process eliminates wheel dressing and grinder readjustment while effectively reducing wheel replacement frequency.

In operation the process utilizes coated abrasive wheels to clean the edges of either hot or cold-rolled sheets. A self-regulating force inherent in the wheels permits constant spindle speeds as the abrasive segments wear.

Designwise, two pairs of wheels are mounted at the grinding station—two above and two below the edges. Electric controls position the wheels at the sheet, automatically compensating for wheel wear during grinding.

* * *

Corrosion-Resistant Fasteners

Plastics which are resistant to deformation under heavy leads have been successfully adapted to the manufacture of bolts. Originally used in fastener applications to protect bolt heads from the corrosive attack of silage, the plastics are now being used in many other applications where corrosion resistance is an important factor. Among these are automobile manufacture and bridge construction.

Although plastic capping of fasteners has been experimented with in the past, it has never been successful in high-torque applications. The usual plastics, however corrosion resistant, are unable to withstand tightening pressures and tear off on the underside of the head. The plastics now being successfully used are a development of Naugatuck Chemical Div. of United States Rubber Co. The process for applying it to bolt heads was developed by Clear-Cite Products of Chicago. Used in place of stainless steel-capped bolts in many applications, plastic-capped bolts reduce fastener costs up to 50 percent.

Low-Expansion Alloy Developed

A new alloy, Fernico-5, whose thermal coefficient of expansion closely matches that of alumina has been developed by the General Electric Research Laboratory. Alumina, a ceramic with desirable properties, has not been used to full advantage in the past because of difficulties in obtaining metal-to-ceramic seals. However, by using the newly developed alloy, manufacturers can obtain good seals in such products as electron tubes, thermionic energy and high-temperature circuits.

Constituents of the alloy include iron, nickel and cobalt. An unusual feature of its metallurgy is the use of vacuum melting to control oxygen levels. In this way other elements such as manganese and silicon which are normally used to control oxygen are omitted. Their absence accounts for Fernico-5's low-thermal expansion. Vacuum melting also provides improved control of the iron-nickel-cobalt ratio—an important factor because the cofficient of expansion is sensitive to changes in the ratio. A third advantage obtained by vacuum melting is the resultant low gas content in the alloy.

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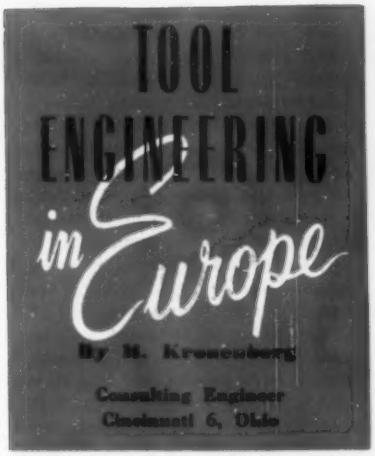


Grinding Wheel Strength

With the development of new plastics, it is possible to cement grinding wheels or wheel segments to steel or aluminum disks, thus avoiding the high stresses usually occurring at the bore of the grinding wheel. Earlier plastic materials did not have sufficient strength for these applications. The number of such cementing agents has been increased greatly by the introduction of highly polymerized synthetic-organic plastics with high strength and high resistance to temperature and coolants.

K. Greiner reports his investigations on the strength and safety of cemented grinding wheels in a doctoral thesis approved by the Institute of Technology at Hannover, West Germany. The title: "Festigkeits Untersuchungen an Kleb-Verbindungen zwischen Schleif- und Tragkoerpern."

The 130-page dissertation contains many diagrams. The author found that the strength of four different cementing agents (out of ten investigated) was greater than that of the grinding materail itself. Strain gages and other modern instrumentation for stress and strain research were used. The cohesive properties of the cementing agent ("Klebstoff") are of primary importance for the strength at the joints, according to the author. Thickness of the cement also affects strength. A thin layer is stronger than a thick layer.

In addition to the test results, the author also presents a thoroughly prepared theory, giving formulas dealing with the forces, stresses, strains and velocities. He gives information on the surface finish required of the metal disks for best cementing action and discusses the effect of coolants and numerous other items.

Dr. Greiner concludes that grinding wheels can be safely cemented to metal disks when the cementing agent is adapted to the requirements of the grinding wheels and grinding conditions and recommends that cementing agents be selected from the class of synthetic highly polymerized plastics. The bonding between metal disk and wheel will be stronger than the wheel itself.

Ceramic Tool Survey

A survey of metalcutting tools—tool steels, high-speed steels, carbides, oxides, ceramics and cermets—and their physical properties and chemical compositions is found in an article by H. Staudinger in *Werkstattstechnik*, Vol. 50, No. 5, p. 254-262. The article title: "Keramische Schneidstoffe."

After a short historical introduction in which he claims that ceramic tools were used in Europe as early as 1905, the author discusses their microstructure. He notes that the ceramic grains are so small that they can be investigated best with the aid of electron microscopes. With electron microscopes it is also possible to find the very small cracks caused by heat concentration and small built-up edges. Photographs of the microstructure of ceramic tools of different origin accompany the article. Differences are due to chemical composition, sintering temperature, sintering time and preparation of the raw materials.

The author correlates the permissible increase in cutting speed with the decrease in bending strength and reduction in chip cross sectional area, and concludes that ceramic tools can be run at about twelve to eighteen times the cutting speed used for high-speed steel tools.

Practical problems, such as clamping of the ceramic tips, soldering and other items are discussed; also cutting temperature and tool geometry. The article concludes with a list of manufacturers of ceramic tools from all industrial countries. Trade names are also listed.

Tool Engineering in Switzerland

About 150 plants in Switzerland are engaged in the production of machine tools. These employ a total of 20,000 engineers and workmen, which is approximately 130 people per plant. This is an impressive figure when compared with the employment in the machine tool industry in other countries. Some 75 percent of the Swiss production is exported, representing an export value of $100.000.000 per year. The Association of Swiss Production Engineers has held a meeting devoted to machine tool and machining problems, as reported in a special issue of *Industrielle Organisation*, Vol. 29, No. 2, 1960. The contributions are partly in German and partly in French.

E. Bickel's introductory article—"Werkzeugmaschinen"—deals with general topics. He feels that the public has no concept of the significance of the machine tool industry. The electronics, jet aircraft and similar industries are better known. Mr. Bickel suggests that machine tools be "glamorized" in order to induce a sufficient number of young men to enter the production field.

H. Wegmueller's contribution deals with the question, "What does the customer expect of the machine tool industry?" ("Was erwartet der Verbaucher von Werkzeugmaschinen?") He lists troubles that he wants to see eliminated, such as the difficulties encountered in repairing machine tools caused by inaccessible parts, difficulties in hydraulic systems, chip removal and many more.

In another article, by E. Kreis, a rather controversial statement is made. A prominent American engineer is supposed to have claimed that the machine tool industry in the Western World is "decadent" and is trailing the Russian machine tool industry. The author asks why such statements have been made and points out that it would be necessary to compare quality as well as over-all production.

A more technical article by M. Widmer deals with drives and controls of machine tools ("Antriebe und Steuerungen von Werkzeugmaschinen"). Electromagnetic clutches are considered by H. Hucks and drives for machine tools are discussed by M. Steinbrunner.

Programmed hydraulic copying devices for the milling of turbine wheel buckets are covered by O. Ronner ("Hydraulische Kopiersteuerung zum Fraesen von Turbinenschaufeln"). He considers plane buckets, curved buckets, and twisted buckets, which are the most difficult buckets to mill. A programming device has been developed for combining "pendulum" and "sweep" milling operations, rendering it possible to mill the buckets in a direction square to their longitudinal axis (pendulum method) and also in the direction of the longitudinal axis (sweep method). Hydraulic difficulties may at first occur; however, they can be overcome after some experience has been gained.

An article by André Mottu covers machine tool guide ways. The title of this article is: "Guidages et paliers de machines-outils." Some of the items covered are the stick-slip motion and virbration of the carriage, the change in the coefficient of friction, roller chains, temperature effect on the accuracy of guiding. It is suggested that these phenomena be studied more

thoroughly than before in order to improve surface finish and accuracy. The author is technical director of the SIP Co., manufacturers of jig borers. Other articles in the machine tool issue of *Industrielle Organisation* deal with guide ways for universal lathes (R. Kuhn), guide ways for heavy machine tools (E. Matthias) and the effect of temperature on the accuracy of collet chucks (A. Daetwyler).

Industry in Red China

Toward the end of 1957 China was manufacturing 220 types of metalcutting machine tools and in 1958 another 145 models were adopted for production according to an article by A. Pekshev and B. V. Lenskii in *Stanki i Instrument*, an English translation of which will be found in *Machines and Tooling*, Vol. 30, No. 10, 1959, p. 6-8. A vertical boring mill with electronic copying device is discussed and illustrated.

A machine tool plant at Kun'min province manufacturers milling machines; one at Shanghai specializes in thread grinding machines; a plant at Nankin produces automatic lathes; multitool automatic copying lathes are made at the Dalnin machine tool factory. The Shenyan machine tool plant makes lathes and grinding machines and a factory is being built at Peking to manufacture milling machines fully designed by Chinese engineers.

A factory at Urumchi is being built for building of heavy machine tools. A plant was opened at Harbin in 1956 for the production of measuring instruments and cutting tools. A plant at Chendu is at present the largest machine tool plant in the country, manufacturing 50 types of machine tools. A large grinding wheel plant is under construction at Chshenchzhov.

Machining of Stainless Steel

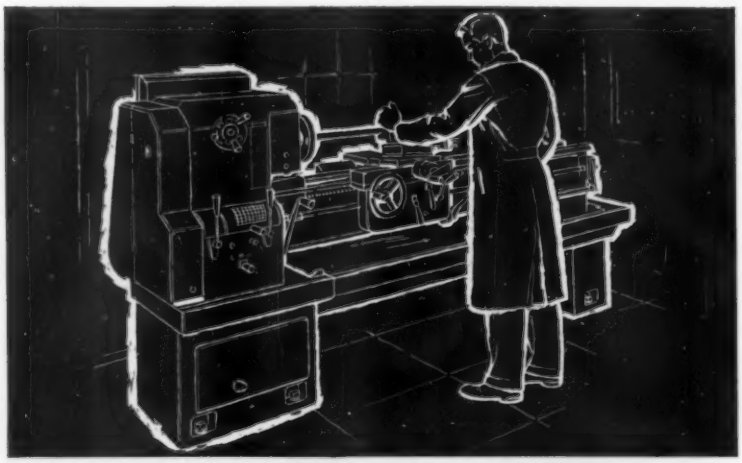
Three different types of stainless steels were machined with various grades of carbide tools in order to find the best combination for machining, according to an article by N. P. Golubev, published in *Stanki I Instrument* and translated into English in *Machines and Tooling*, Vol. 30, 1959, No. 10.

The data given in the article refer mostly to a stainless steel with 17-20 percent Cr, 8-11 percent Ni and up to 0.8 percent Ti, 2.0 percent Mn, (corresponding approximately to American standard SAE 321). The best tool life and the least wear, measured in length of time required to obtain a flank wear of 0.040 inch, was recorded for a carbide tool T 5-K10, composed of 85 percent WC, 6 percent TiC and 9 percent Co.

Tool Wear

Results of tool wear investigations by E. V. Ryshkov have been published in an article in *Stanki i Instrument* and translated into English in *Machines and Tooling*, Vol. 30, No. 10, 1959, p. 36-37.

The purpose of the study was to find out what influence tool geometry and cutting conditions have on some types of carbides. The workpieces were about 20 inches long and had a diameter of about 4½ inches. The interesting feature of these tests is the finding that the wear increased sharply at low speeds, when measuring the length of the path cut at various cutting speeds. Best results were obtained at a speed of about 270 fmp, where the flank wear reached the same value after cutting of 15,000 feet of circumferential path as with a cutting speed of 100 fpm after cutting a path of only 1600 feet. In this writer's opinion, the poor showing at low speeds is caused by self-induced vibration which is more pro-



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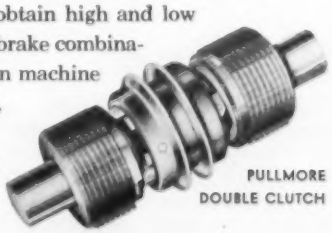

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nounced at low speeds due to the steeper reduction in cutting force with increasing speeds in the low-speed range as compared with higher ranges.

Kilogram and Kilopond

A new unit—the "kilopond" (abbreviated "kp") has been introduced in the metric system. The new unit replaces the kilogram to express force. Henceforth, the kilogram refers only to mass. Both quantities are linked, as before, by Newton's law—force equals mass times acceleration. Until now, it has always been necessary to indicate whether the kilogram referred to force or mass.

Implications of the new metric unit are covered in P. Steglich's article "Mathematisch—physikalische Zusammenhaenge fuer die Umstellung auf das Internationale Einheitensystem." The article appears in *Werkstatt und Betrieb*, Vol. 93, No. 5, 1960, p. 254-258. Some of the more complex relationships that are affected by the new unit—gas-constant, heat and others—are also covered. Equations and definitions are included with the article.

Copying Device Errors

Static and dynamic errors in copying devices can be analyzed mathematically, using an approach developed by G. Kleimenhagen. The approach was presented at the recent machine tool meeting of the Association of Swiss Production Engineers. An abstract has been published in *Werkstatt und Betrieb*, May 1960, Vol. 93, No. 5, p. 225-228. The title: "Zur Beurteilung von Nachform Einrichtungen an Drehbaenken." Causes and effect of errors in the reversal of motion—and velocity errors—are discussed. Other causes of static errors include the resilience of the system and the boost in force required to produce motion. Dynamic errors occur in the case of large accelerations of the system. These errors are often found in copying devices for producing non-circular workpieces. The author suggests selecting a sinosoidal relationship when investigating the dynamic properties of a copying device and expressing the quality in terms of dimensionless quantities, which include the maximum force, maximum stroke, maximum velocity and simliar quantities. In this way it would even be possible to compare copying devices of different sizes.

Measuring Surface Finishes

Only a relatively small number of tool engineers are familiar with the fact that surface finish designations in microinches may signify different dimensional deviations in the United States and Europe. J. Perthen has written an article dealing with the question of measuring surface finish in the machine shop and covering the various measuring systems. It appears in *T.Z. fuer praktische Metalbearbeitung*, Vol. 53, No. 6, p. 217-222, under the title: "Warum Oberflaechen Pruefung im Betrieb?"

In Germany the "Rauhtiefe" (roughness-valley) is usually taken to indicate surface finish. It is the value of the greatest depth of the surface relative to the greatest peak. Such system, it is claimed by the author, represents values closely associated with the feed and depth of cut taken on a machine tool and can readily be realized by the man in the shop.

Another dimension, the "Glättungs Tiefe" (smoothness valley), is the distance of a reworked surface from the initial peaks. A good surface finish is indicated when this dimension is small.

The portion of the profile supporting a load in the longitudinal direction of the ups and downs of a surface gives valuable information on the rigidity or strength of a surface, its resistance to wear, running quality of bearings and the like.

The arithmetical mean of the roughness valleys is used in England (CLA) and in the United States (AA). The author claims that this system is not as good as the previously mentioned methods since it involves a mathematical concept which is difficult to understand when used in the machine shop. It has, however, the advantage of reduced scattering of data, and permits the use of relatively simple surface measuring instruments. The geometrical mean used in the U.S. is rms.

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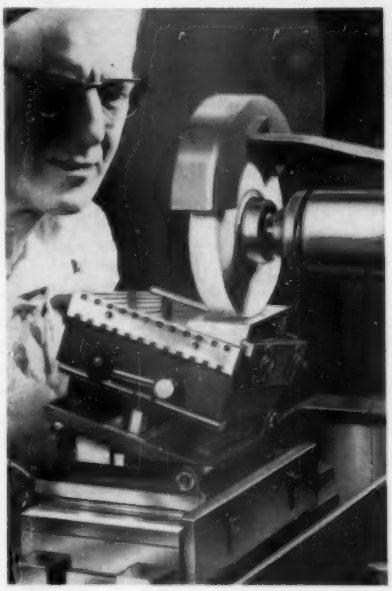

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Field Notes

Bausch & Lomb Optical Co., Rochester, N. Y., is now officially **Bausch & Lomb Inc.** The new name, recently approved by company stockholders, recognizes the fact that B&L is not restricting its research and manufacturing interests to the field of optics alone.

acquisitions

Onsrud Machine Works, Inc. has announced purchase of the Hydraulic Press Div. of Berthelsen Engineering Works, Inc., Joliet, Illinois. The newly-acquired products line includes heated-platen single and multi-opening presses for laminating plywood, reconstituted board products, metal, plastics and rubber.

Agreement on joint ownership of a California electronic systems engineering firm by **Allis-Chalmers Mfg. Co.** and **Bell & Howell** was announced recently. Allis-Chalmers has acquired 50 percent of the common stock of Consolidated Systems Corp., Monrovia, Calif., a wholly owned subsidiary of Bell & Howell's Consolidated Electrodynamics Corp.

association news

The Detroit-headquartered **Society of Reproduction Engineers** has elected the following officers to serve for the 1960-61 term: Albert J. Prioletta, president; George F. Weidman, Everett Kaestner and Frank E. Golightly, vice president; William J. Burdick, secretary for a second term; and R. H. DeRosa, treasurer.

Establishment of an Institute for the Certification of Engineering Technicians and Engineering Technologists has been approved by the Board of Directors of the **National Society of Professional Engineers.** The Society will organize and operate the Institute to determine by examination, endorsement, or otherwise, the qualifications of all persons who apply for certification and to grant a certificate in the appropriate grade to applicants who successfully meet the criteria for certification.

awards

Kennametal Inc. has won first place in the Association of Industrial Advertisers annual "Best Seller" competition, with a campaign to sell carbide cutting inserts to the metalworking field.

Alvin M. Weinberg, director of Oak Ridge National Laboratory, was named one of five recipients of the **Ernest Orlando Lawrence Memorial Award** for 1960 "for outstanding contributions to nuclear reactor theory, and for pioneering work in the design of production, research and power reactors." The award was established last December by the Atomic Energy Commission in memory of the late Dr. Lawrence, former director of the laboratory bearing his name at Berkeley and Livermore, California.

The Industrial Safety Association of Iowa has cited the **Maytag Co.** Hampton plant for its sixth consecutive year of operation without a lost-time accident.

R. Byron Bird, professor of chemical engineering at the University of Wisconsin, has been awarded the $1,000 **George Westinghouse Award** for outstanding teaching ability in a young engineering faculty member.

expansions

Veeder-Root Inc., manufacturers of computers and counting instruments, is expanding its West Coast operations to include manufacturing as well as sales and service with the establishment of a plant located at Park Place, Glendale, Calif. Known as **Veeder-Root Western,** the new plant will provide manufacturing facilities for modification and testing of mechanical and electro-mechanical counting instruments for West Coast industry.

Expansion and modernization of plant facilities has been announced by **H. R. Krueger & Co.** Formerly the Krueger-Barnes Corp., the Detroit firm is a supplier of machine tools and automation equipment to the automotive and allied industries.

Dodge Manufacturing Corp. has announced formation of a wholly-owned subsidiary, Dodge Mfg. International, A. G., with headquarters in Zug, Switzerland. Dodge International has also acquired majority interest in a new operating subsidiary, Dodge de Mexico, S. A., with headquarters in Mexico City.

General Electric will add another 260,000 square feet of office, engineering and manufacturing space to its transistor and tunnel diode facilities in Electronics Park, N. Y. within the next few months.

The Heald Machine Co. is expanding facilities for assembly and testing numerically controlled machine tools at its Worcester, Mass., plant. A special air conditioned and humidity controlled enclosed area containing 2400 square feet has been built inside the plant for assembly and runoff testing of the machines. It will supplement present facilities for manufacturing numerical control and special purpose classifiied machines.

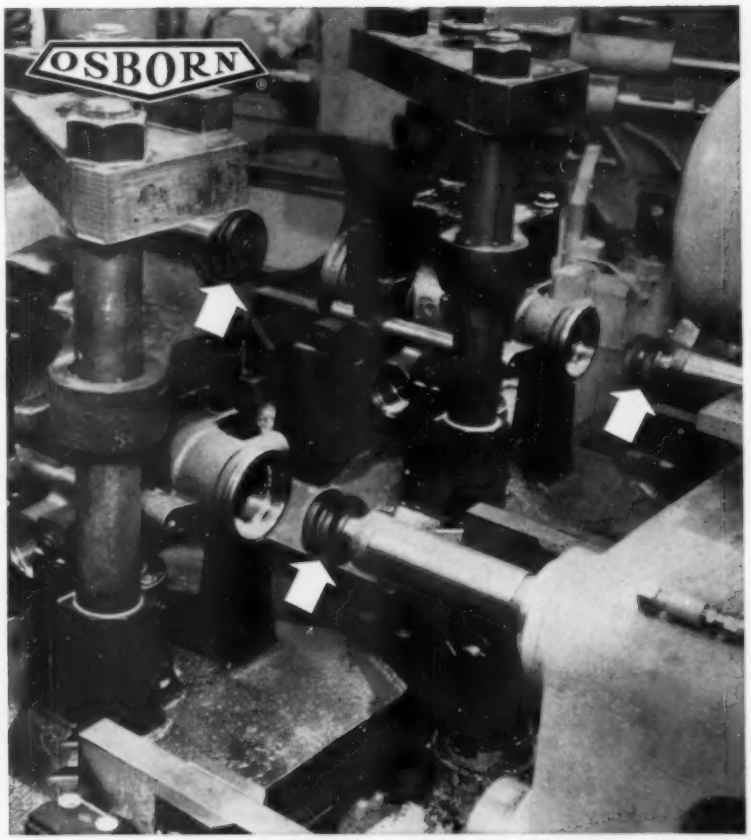
Ultrasonic Industries Inc. has announced the formation of a Canadian subsidiary, Ultrasonic Industries (Canada) Ltd., Toronto, Ontario, the first of several such companies contemplated by UI in the development of international markets for its ultrasonic cleaning equipment and other ultrasonic devices.

Formation of a new company in Switzerland is spearheading a major expansion of operations in Western Europe for **Burroughs Corp.** Named Borroughs International S. A., the company will have headquarters in Fribourg, Switzerland. E. G. Wallace, who has been general sales manager for the firms' International Division since 1954, has been named president and managing director.

mergers

The boards of directors of **Barry Controls, Inc.** and **The Wright Line, Inc.** have voted to recommend to their respective stockholders that there be a merger of the two companies, with exchange of stock of the two companies on a share-for-share basis for stock of the consolidated company. One class of stock having full voting privileges will be provided by the newly consolidated Barry-Wright Corp.

Two Los Angeles firms, **Precision Processing Co.** and **King Machine and Mfg. Co.,** have merged, combining personnel and maufacturing facilities of both companies. The new organization will retain the King name.



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Field Notes

Announcement has been made by **The DeVilbiss Co.**, Toledo, that its wholly owned subsidiary, DeVilbiss Metal Fabricators Co., has become an operating division under the name, The DeVilbiss Co., Metal Fabricators Div.

new activities

Acme-Efco Ltd. has been formed to market the complete line of Acme polishing and buffing machines. The new company is owned jointly by **Acme Mfg. Co.**, Detroit, Mich. and **Electro-Chemical Engineering Co., Ltd.**, Sheerwater, Woking, Surrey, England.

Hughes Aircraft Company's ground systems group has established a computer laboratory in a central facility with a staff of 600 employees at Fullerton, Calif. The laboratory has been divided into sections working on land based and seaborne computer systems, general purpose computer systems and computer advanced development.

American Brake Shoe Co. has formed an Industrial Castings Group composed of four of the company's divisions. Group executive is vice president Paul L. McCulloch, Jr. Divisions of the group are American Manganese Steel, Electro-Alloys, Engineered Castings, and National Bearing.

new facilities

Construction of the new plant of **United States Drill Head Co.**, Cincinnati, Ohio, is under way at the 14-acre site at 5298 River Rd. Expected occupancy of the new structure by September 1 will mark completion of the ¾-million dollar building program begun by the company in 1957.

A new $500,000 production center for cold-wound springs has been opened at Chicago Heights, Ill., by **ALCO Products, Inc.** Completion of the new construction centers the company's production of industrial and railroad springs in one location.

The National Bureau of Standards, U. S. Dept. of Commerce, has announced that work will begin during the next 12 months on site development and construction of the first three building units for the new Bureau laboratories to be located at Gaithersburg, Md.

Tech Digests

Controlling Manufacturing Costs

Specific concepts and practices have proven effective in controlling manufacturing costs. Criteria for effective manufacturing controls are listed and illustrated by seven different control forms. By means of such forms, the efforts of many people can be coordinated toward the end of controlling manufacturing expense. The paper work involved provides good measuring sticks, permitting clear-cut decisions and thus for management to be effective.

Based on SAE Paper 156B by R. M. Lynas, Thompson-Ramo-Wooldridge, Inc. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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Machinability of Sintered Iron

Because of tight tolerances, undercuts, threads, annular grooves and so forth, many parts made from metal powders must be machined. Mix composition and sintering affect machinability. As a guide, thirteen different mix compositions were investigated. Factors studied were microstructures, tool life, surface finish and tear point. Copper, sulfur and phosphorus have a beneficial hardening effect that moves the tear point to higher feed rates. Small sulfur or large copper additions improve tool life, while phosphorous additions are detrimental.

Based on a paper by Roy S. Jamison and Ernst Geijer, Hoeganaes Sponge Iron Corp., presented at the 15th Annual Meeting of Metal Powder Industries Federation, 60 E. 42nd St., New York 17, N. Y.

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Recognizing Fracture Patterns

Fracture patterns often show the cause of failure of a welded joint. Defects in weld metal such as hot cracks and crater cracks exhibit a fracture pattern quite unlike that of sound weld metal. The purpose of this paper is to help the observer recognize this pattern and understand its significance.

When sound metal fails at ordinary temperatures in static tests or in fatigue, the fracture will be through the grains in what is called a transgranular fracture. When weld metal above some elevated temperature fails by separation along the grain boundaries, the fracture will be an intergranular or grain-boundary fracture. The transgranular fracture has a patternless, rough surface somewhat like wrinkled sandpaper, while the grain-boundary fracture has a block-like surface resulting from the exposure of many more-or-less flat grain faces.

A ruptured propellant tank is used to illustrate these fracture types. On this tank, the fracture study led to the conclusion that a tight welding hot crack was following the torch for the first several inches of the seam. Corrective measures are discussed.

Based on a paper by William L. Burch, Bell Aircraft Corp., presented at the 41st Annual Meeting of the American Welding Society, 33 W. 39th St., New York 18, N. Y.

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Electrolytic Machining

Metal removal using electrochemical action, called electrolytic machining, is different from electrical discharge machining. The electrolytic technique has five areas of applications where its characteristics give it advantages over other methods: single point carbide tool grinding (tool costs can be less than throwaway tooling) sharpening carbide-tipped milling cutters, recently improved by new machine designs; producing parts of materials that are tough, stringy or temperature sensitive; grinding large tools of high-speed steel; and cavity sinking. Removal rates of 18 cubic inches per hour can be achieved without metallurgical damage to the work material or the electrode. Offsetting these advantages are the disadvantages of the plumbing required for handling the corrosive electrolyte solution and the cost of making electrodes.

Based on a paper by Lynn A. Williams, Anocut Engineering Co., presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

Electronics and Machine Tools

To indicate trends and possible future developments, the experience of machine tool builders over the past 25 years is reviewed, with emphasis on the role played by electrical engineering and JIC standards. Present-day developments, such as electronic servo drives that replace earlier mechanical linkages are briefly described. The trend toward electronics presents tool builders with certain questions—whether to design and build their own controls or to use the talents and facilities of a systems builder—and how to determine maintenance responsibilities. Standardization of components, information from electrical manufacturers, and coordination among tool builders is required to make the application of electronic controls to machine tools smoother than the electrification of machine tools.

Based on a paper by Leonard C. Michelson, Gleason Works, presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

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Bonding Carbide to Steel

Many potential applications for tungsten carbide tools cannot be realized because of the weakness of the joint between carbide and steel. Mechanically clamped joints and brazed joints are not always satisfactory. A new method produced by the powder metallurgy technique has been devised and tested. Using relatively low time, temperature and pressure of bonding, a wafer of the bonding material is diffused to create a strong and shock resistant joint between carbide and steel. During the development of the method, a large number of variables was studied and tested to determine

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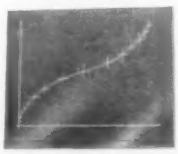
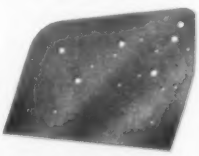
This table-type, extremely accurate machine drills, reams, center punches and scribes *without* base line drawings or vernier height gauges. Positioning of the bridge and drill carriage is done with adjustable steel tapes calibrated to 0.100". Micrometric gauges then bring the setting to the nearest 0.001". Lead screws are precision ground and engaged only during micrometric gauge settings, thus speeding adjustment and minimizing wear. Capacity is ¼" mild steel—up to 24" width—any length.

Anybody who can read blueprints and knows something about layout practice can learn to work the Strippit Flex-O-Drill in a few minutes. We'll be happy to prove this with an actual demonstration at your own plant. Write for information today.

A typical Strippit Flex-O-Drill drilled template.



A typical Strippit Flex-O-Drill scribed layout.



A typical Strippit Flex-O-Drill production piece.

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optimum bonding conditions. As a result of this work, it is expected that the high strength and heat resistant joint achieved will enable new uses of carbide and other refractory metals.

Based on a paper by Jerome F. Kuzmick and Glenn B. Goodfellow, Powder Alloys Corp., presented at the 15th Annual Meeting of Metal Powder Industries Federation, 60 E. 42nd St., New York 17, N. Y.

Vibration and Sound

Vibration and sound reduction is necessary for greater industrial precision, to minimize compensation payments for loss of hearing, to meet government codes regarding noise and to meet certain military specifications. Using electronic computers for the extensive calculations required, mechanical structures were analyzed. Bearing noises, structure-borne vibration and other types of vibration and noise were studied using accelerometers, dial indicators, transducers, metering systems and tests in semianechoic chambers. Noise and vibration sources can be pinpointed and minimized by these techniques.

Based on a paper by Robert B. Edminston, Westinghouse Electric Corp., presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

Future Trends in Materials Removal Techniques

We have now reached the outermost fringes of this procedure of examining trends and their portents for the future. It's now time to call a halt to this and stand back to observe the general patterns found and draw a few conclusions. It is evident, of course, that in the field of machining our problems seem to be increasing at an exponential rate, but this is normal and usual in practically all technical fields. However, we have also seen that in all the areas which we have examined our rate of improvement in machining over the years has also been exponential. Further, in all these cases we have found no sign of leveling off in the rate of improvement and, in fact, in most cases the rate has actually increased since about 1900. This latter behavior may well be due to the catalytic effect of industrial research, which has appeared on the scene as a powerful entity since that date. A composite of all the trends suggests that our rate of improvement corresponds to an approximate doubling of effectiveness every ten years. Even so, this seems hardly sufficient for the future. It would appear that prog-

Gaertner Toolmakers' Microscope used to measure typical piece part. Co-ordinate range 4" x 2".

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With the Gaertner Toolmakers' Microscope you make direct, non-destructive measurements — no contact, no distortion, images are sharp and clear. It is a basic measuring instrument for inspection depts., gage labs, tool and die and model shops, industrial and research labs.

The Gaertner Toolmakers' Microscope has been proven in use by U. S. Government Gage Laboratories, and by prime contractors and their subcontractors. With all parties using the same measuring instrument, inspection procedures are co-ordinated and disagreements and rejects minimized.

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HIGH SETTING AND REPEATING ACCURACY

- Low, compact built-in rotary stage reads to 1 minute of arc throughout 360° range.
- Minimum overhang of stages.
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- Thread and radius templates, camera and spotting attachments, fine motion focus, variable magnification available.
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ress in improvement of the metal-removal process has been too easy in the past, that the challenge has not been great enough to generate a large-scale, well-organized, well-planned technical research attack. Only in very recent years has the need for such an approach gradually begun to be realized. It seems evident now that to go on from here will not be as easy. An increasing research attack must be mounted with well-defined objectives and with coordinated usage of scientific and engineering approaches. We have seen that there are a number of areas of high potential to be attacked in such a program. These include the areas of improvement of automation of metal removal, improvement of tool materials, improvement of tool geometry, modification of work material properties in situ, improvements in the grinding process, further exploration of the possibilities of electrical machining (of which electrochemical machining, electron beam machining and plasmajet are only examples) and, finally, attack on the general problem of the use of energy—physical, chemical, electrical, nuclear or other—to remove metal.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Based on SAE Paper No. T40 by M. Eugene Merchant, The Cincinnati Milling Machine Co. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

Paperwork Simplification

Paperwork simplification is the organized application of common sense by everyone to eliminate waste. These last three words are very important. In fact, they form the key to the entire program; no one wants to eliminate a necessary piece of paper. We think that paperwork simplification is needed because of the tremendous amount of dollars being poured into the generation of paperwork.

Paperwork simplification can be applied in any area or by any individual, and the entire organization will benefit. The employees will have better security; the company will become more competitive; and the customer will obtain a cheaper and a better product. But it takes much more than lip service to get into action. It takes real people to participate by developing a sincere

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Here at Baird we build Automatic Multiple Spindle Chuckers, Transfer Presses, Vertical Lathes, Bench Power Presses, and Four-Slide machines. Just for the moment, let's sidestep the usual claims of quality, accuracy, precision, and performance. Let's look at the men in both large and small companies all over the country who are entrusted with the responsibility of deciding what automatic machinery to buy . . . whose to buy . . . and when to buy them.

Baird has a special meaning to these people for a very simple reason. They have come to rely, not only on the products of Baird, but on the Baird way of working with them. When their machines arrive, they are in top operating order, ready for production. No waiting for them to be "finished on the floor".

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questioning attitude: What is done? Why is it done? Where should this be done? When should this be done? Who should do it? How should it be done?

Supervisors and management too should be much interested in reducing the paper mill. They also should participate by asking themselves: Why do I receive this information? Is it necessary or just convenient? How much does this information cost and is it worth it? Why do I receive this information as often as I do, and what would happen if I didnt receive it at all?

By asking himself these questions in a truly objective fashion, each manager should be in a much better position to evaluate the true worth of the information contained in reports fed periodically to him.

While there are a number of ways to get going, the important thing is to get started, and to get started along the lines of an organized, systematic plan. The attack should probably begin by selecting a job to improve—a not-so-easy task in itself. This is true because the things that need improvement are not always apparent. It is easy to walk

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

by the same unhealthy situation day after day without seeing it. Sometimes we are so close to the job that we cannot see the undesirable features of it. We should look for bottlenecks—jobs that take too much time, jobs where our costs are too high, and jobs that require too much handling, too much chasing around. Reports that contain too much raw data, that seem to be too thick, that come out too late are fair game. Then we have to get the facts. Trying to solve a problem without knowledge of the basic facts is rarely worthwhile. Make a process chart. Until these details are outlined in their entirety, it is almost impossible to successfully think about the job as a whole. Many a manager has found himself baffled or irritated by an inability to visualize the whole operation all at once in each of its many details. He must therefore occasionally make decisions based on incomplete knowledge, and obviously this is not good.

Based on SAE Paper No. 156A by H. A. Helstrom, Jr., Chance Vought Aircraft, Inc., entitled "Reducing the Paper Mill Through Methods and Systems Simplification." Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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Adjustable Speed Drives

Machine tool users expect better performance and control which often leads to a problem in selecting the best means of adjustable speed in the drive. Seven types are described and analysed for performance characteristics. Results are summarized for quick comparison in tables. Selection of the best drive for a given application is done by knowing the possibilities of each drive and matching machine tool requirements to drive characteristics. Final selection can be made when all economic factors of initial, operating and maintenance costs are evaluated.

Based on a paper by E. C. Watson, Westinghouse Electric Corp., presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

Plant Design

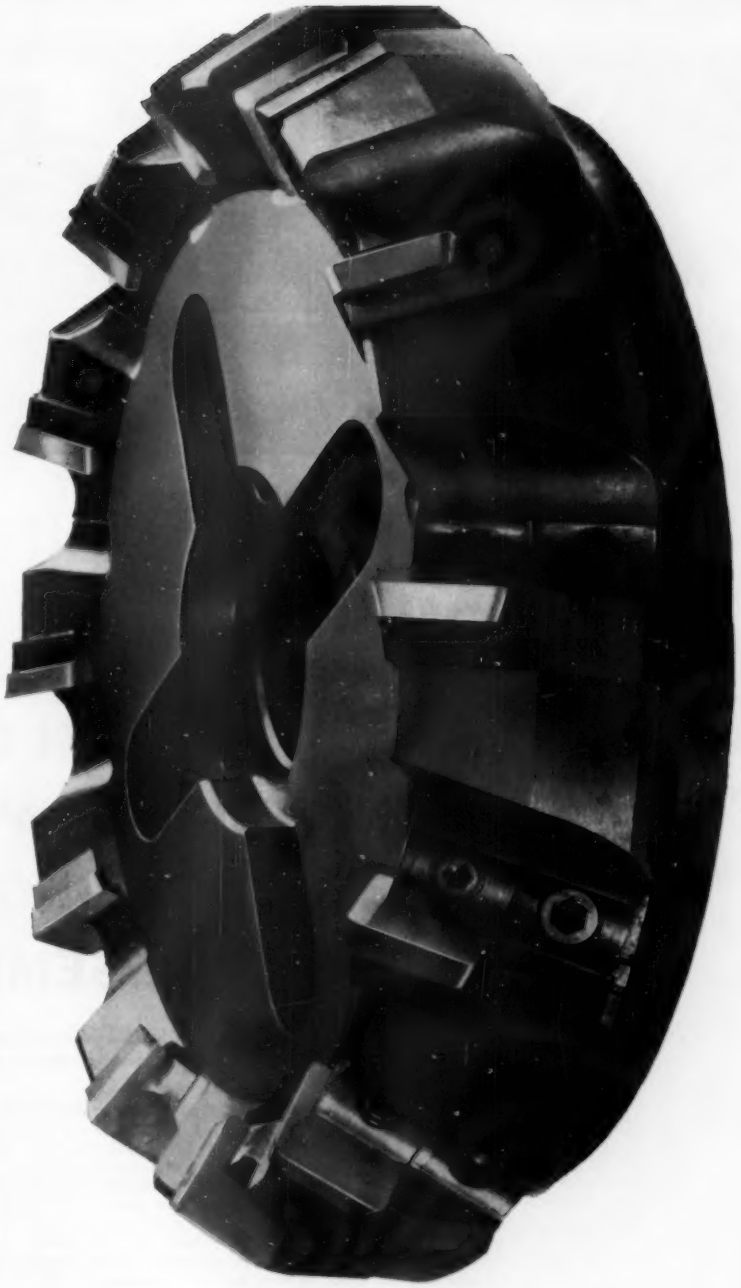
Designing a plant is similar to planning a manufacturing process. Flow charts, template layouts and other techniques are aids in the planning. for total factory operation, process determination, production layout, building design and equipment design are all necessary. Material handling, processing, services, assembly scheduling and sequencing must all be considered. The plant design must be evaluated and setup to produce the desired product at the lowest cost.

Based on a paper by Charles E. Pflug, American Motors Corp., presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

Electrical Discharge Machining

Electrical discharge machining can reduce costs, improve products and permit unusual designs. Two types of equipment are used—high-energy discharge at low frequency and low-energy spark at high frequency. Each has certain advantages and disadvantages. Typical applications where the technique pays off are machining dies, upgrading die materials, precision holes such as valve ports and slots, machining "unmachinable" materials such as zirconium and beryllium and machining fragile parts. Equipment developments and experience in the technique have made electrical discharge machining as conventional a method of metal removal as milling, drilling and grinding.

Based on a paper by C. B. Minturn, Cincinnati Milling and Grinding Machines, Inc., presented at the 24th Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.



How efficient are Joydex cutters? We quote from a recent performance report: "Facing and rough milling a chrome-moly vanadium casting (Brinell 250) to a depth of ⅞" at cutting speed of 200 SFPM, the 12" dia. Joydex milled approximately 300 cu. in. per blade edge. Performance was beautiful."

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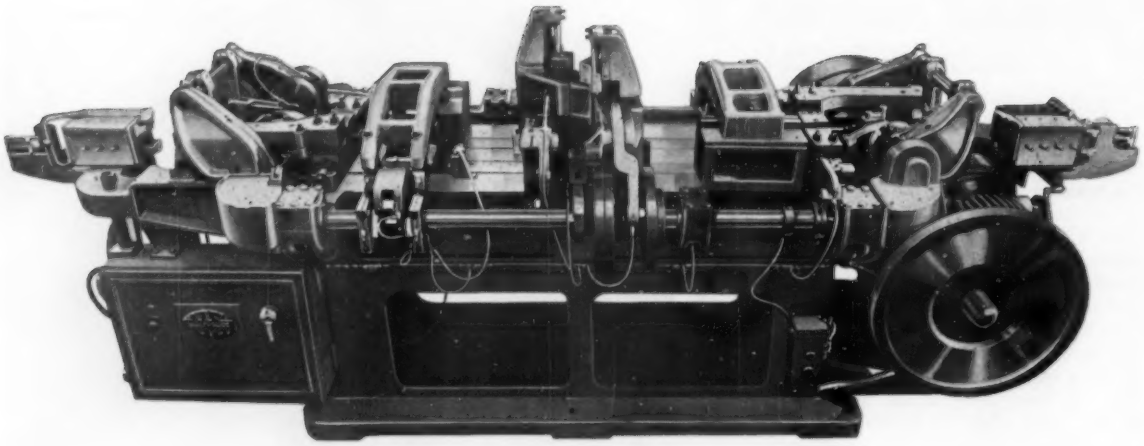

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SIMULTANEOUSLY

FEEDS AT BOTH ENDS & PRODUCES TWO OR MORE STAMPINGS & FORMS & ASSEMBLES

The new U.S. Duplex Multi-Slide is a double ended machine which more than doubles previous production potentials.

With the U. S. Duplex you can ■ Produce and assemble 2 different stampings from the same or dissimilar materials. ■ Produce and assemble 2 complementary stampings. ■ Produce stampings from one end, wire form from the other end and assemble. ■ Produce 2 stampings and assemble with hopper-fed, prefabricated parts. ■ Make 3 piece assemblies, feeding material from both ends — and from the top. ■ Make 2 or more identical or different stampings not requiring assembly — and of the same or different material. ■ And, can be operated as a conventional Multi-Slide by feeding material into one end only. **Standard U.S. Duplex Multi-Slide equipment includes a feed, stock straightener, check and ram action at each end and a common 4-slide forming position with double, vertical strippers at the center. Material up to 3" wide can be fed into both ends of machine simultaneously. Feed length is adjustable up to a maximum of 6" and can differ from each end of the machine. Investigate the economies a U.S. Duplex Multi-Slide can give you. A few of these are: elimination of secondary operations; savings in floor space; ease of inspection of finished assemblies; and fewer rejects . . . all through the versatility of the "Duplex".**

Write today for full information and specifications. Send us your samples or drawings today and let us show you.

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its specifications add up
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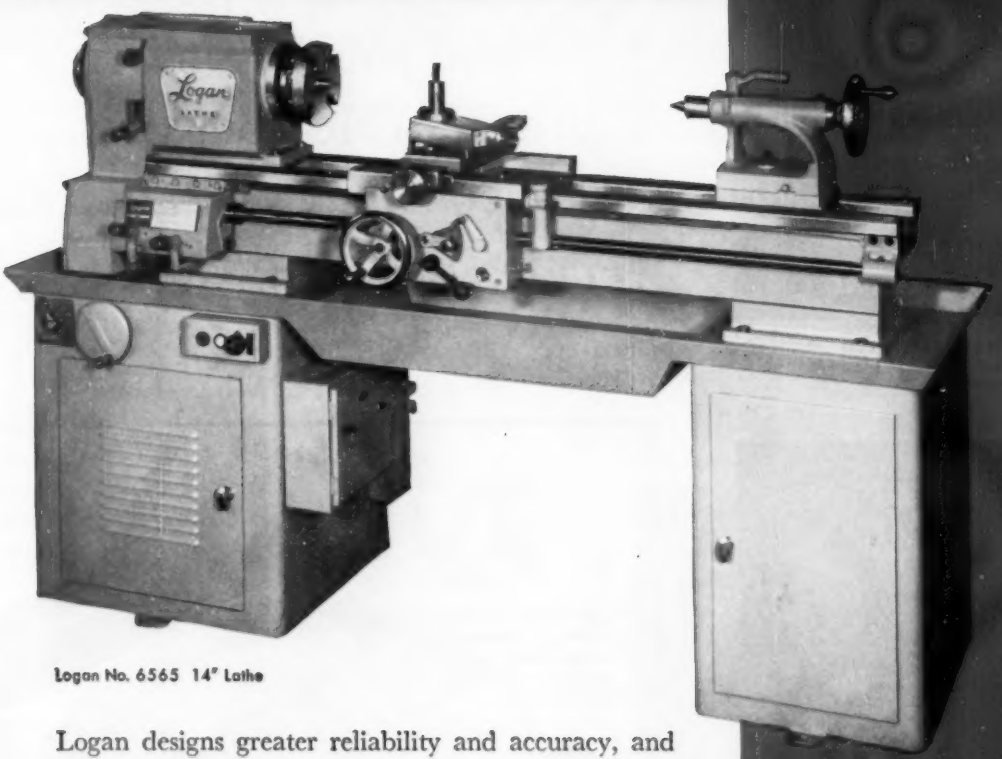
Logan
14" Lathe



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Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-quality features. For instance—

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- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

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- Spindle speeds to 2000 rpm.
- 1½" Levermatic collet chuck capacity
- 14⅜" swing over bed
- 9" swing over saddle cross slide
- 40" between centers

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Metallurgical Memo from General Electric

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Hand-honing is inaccurate, time-consuming—often results in premature chipping and breaking.

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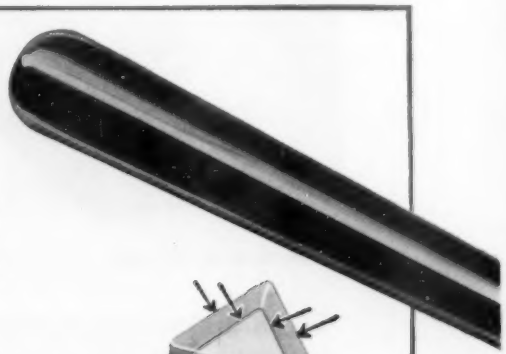
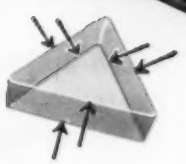
Unhoned or as-ground inserts show rough edges—result in unpredictable tool life due to chipping.

Now you get more predictable tool life... lower cost per cutting edge ...no hand-honing cost!

Pre-honed inserts with uniform, precise honed edges offer top strength; improve tool life predictability.



Additional savings result through the elimination of costly and often inaccurate hand-honing methods.



Because chipping and breaking are minimized, pre-honed Carboloy inserts result in lower average cost per cutting edge.

TOPS IN TOOLING QUALITY

From the research and quality-control facilities of the Metallurgical Products Department of General Electric comes the outstanding quality tooling line in the metalworking industry. The new Carboloy pre-honed inserts, as well as the complete line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling, are designed to meet every tooling need efficiently and economically.

CARBOLOY® INSERTS

Delivered ready-to-use . . . honed to a precise radius . . . promise BETTER PROFITS THROUGH BETTER TOOLING

Now General Electric Carboloy inserts are pre-honed *at the factory!* Here's what it means to you:

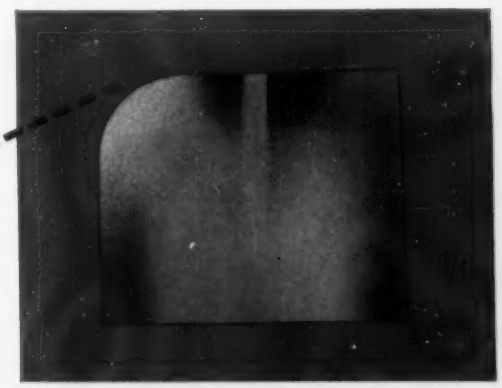
1. An insert with edges honed to precise *radii* gives the strongest geometric shape to withstand cutting pressures. This reduces the chance of chipping—increases the predictability of tool life. Hand honing *cannot* achieve precise radii—G-E pre-honing can . . . and does!

2. Since chipping is minimized, fewer cutting edges are wasted. The result is lower cost per cutting edge.

3. Since inserts come pre-honed and ready-to-use, the labor cost and inaccuracies of hand honing are eliminated. This more than offsets the additional charge for pre-honing.

4. Pre-honed Carboloy cemented carbide inserts have standard edge radii honed to a greater or lesser degree, depending on the job to be done. You'll *know* the honing is right!

Ask your Authorized Carboloy Distributor about pre-honed Carboloy inserts, convertible seats, toolholders, and brazed tools. Or, write directly to: *Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Street, Detroit 32, Michigan.*



Shown here, both under magnification and graphically, is an edge of the new Carboloy pre-honed insert. Radius is geometrically ideal to minimize chipping, extend tool life many times.

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Problem: *Drill and tap ojival, conical, and cylindrical sections for missile components.*

Solution: A BarnesdriL 2-spindle tape-controlled unit with four-motion-control, including a head that tilts to 15° plus or minus off horizontal center. Capable of handling parts to 36″ diameter and 72″ high, this unit gives ±.003″ positioning accuracy with repeatability to ±.0005″. Holes can be spaced

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in set-up and machining time. Individual spindles are tape-controlled to operate from 3 different feed-out ratios, entirely eliminating tool changes. The machine has the ability to select exact position, hole size, and cutting depth quickly, and with extreme accuracy. Positioning is guaranteed to .003″, depth to .001″, and repeatability to .0002″, making it a highly flexible production machine for cylindrical parts up to 50″ in diameter and 40″ in height.

Problem: *Cut production costs on a variety of boiler plate and bolt circle work.*

Solution: A BarnesdriL numerical control unit cuts production time by 47%. This

is a single-spindle drilling machine with vertical spindle travel and a rotary indexing table with capacity to 50″ diameter and 42″ in height. Operations include combination drilling-countersinking, drilling-counterboring, straight drilling, reaming, counterboring, and countersinking.

Problem: *Informing every cost-conscious metalworking executive of other BarnesdriL advances and advantages in tape control machining.*

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There'll be the numerically controlled machine that has created *an entirely NEW Manufacturing Concept*—the 100th MILWAUKEE-MATIC right off the line . . . the *NEW "S" Series* knee-type milling machines . . . the famous heavy-duty, *"TF"* twin-screw, knee-type milling machines . . . the *Mil-waukee-Mil*—bed-type production mills featuring *"Dial-A-Cycle"* program control and optional tracer control . . . the *Model "D"* Rotary Head Machines that simplify complex machining into a single setup . . . all these and many more—plus factory personnel to answer your questions, and help solve your specific machining problems.

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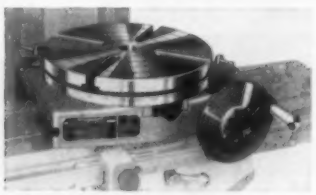

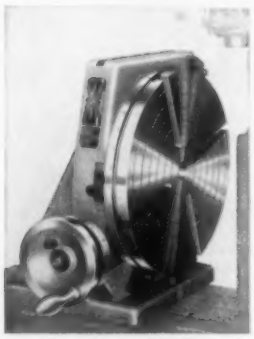

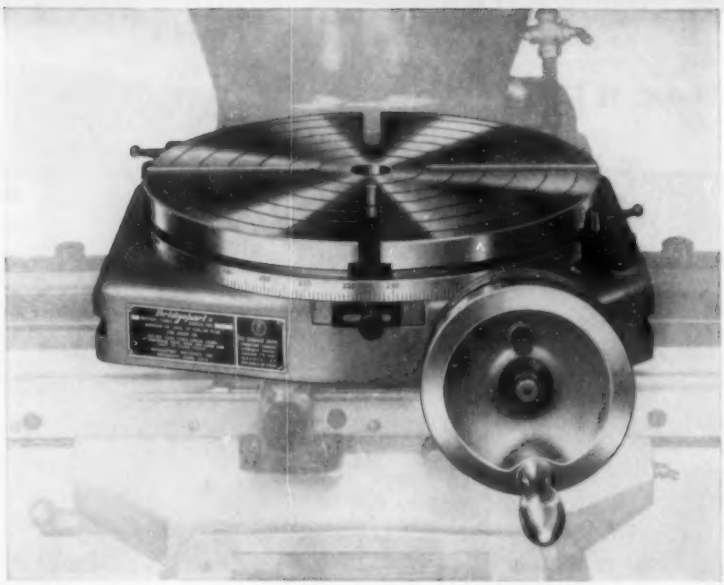

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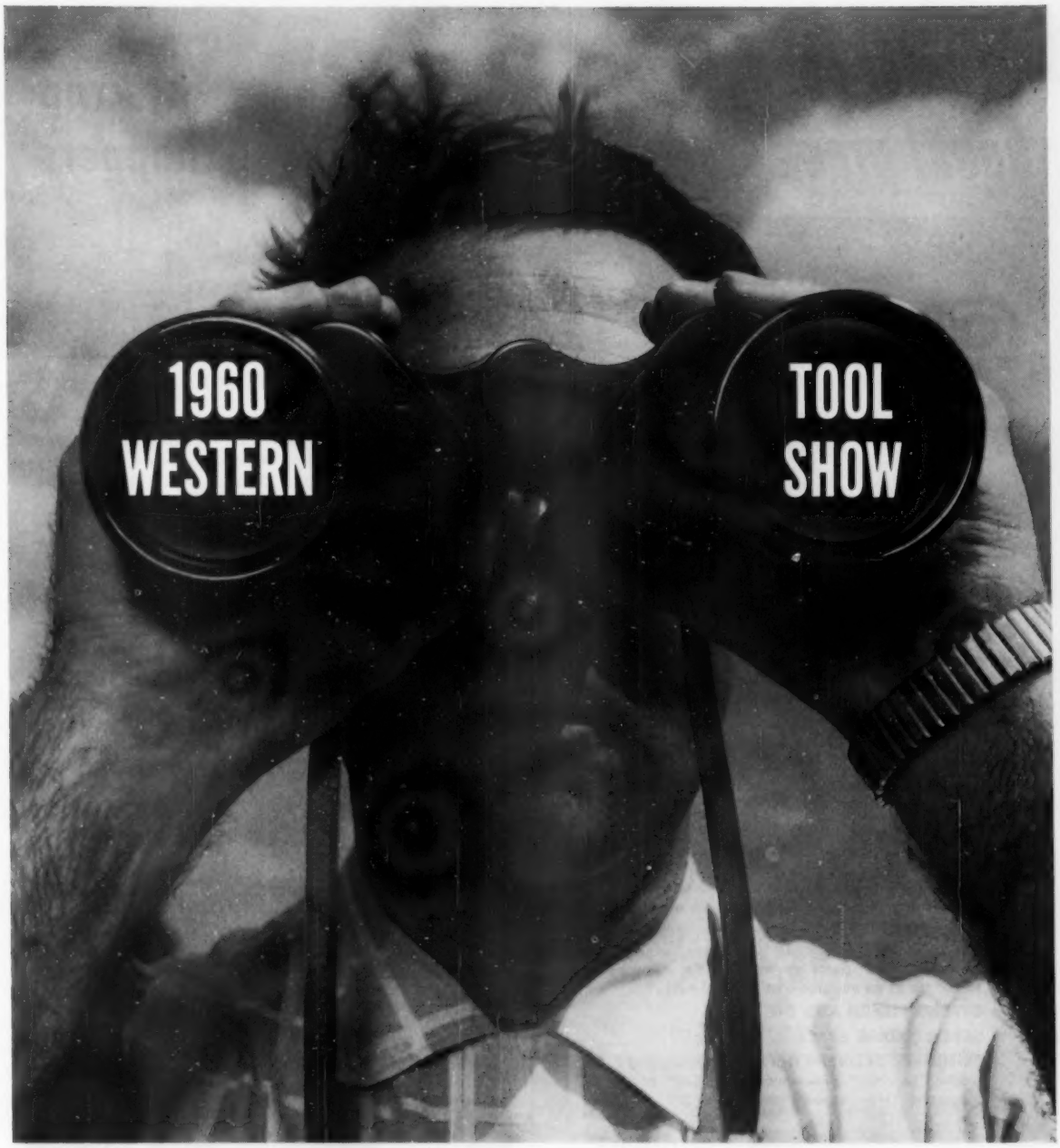
"The Most for the Least"

WORM and SHAFT	One piece — Hardened and Ground — Alloy Steel.
GEAR	Normalized cast iron fastened to table and machined to extremely close tolerances. Worm can be disengaged to facilitate set up. Adjustment has been provided for the following: worm end play, table radial play, table thrust, backlash of worm.
GRADUATIONS	Table graduated every degree, dial every minute, adjustable zero mark, adjustable dial.
BEARING	Anti-friction, adjustable roller bearing for radial play, adjusting thrust washer for end play.
LUBRICATION	Worm and gear immersed in heavy oil, oil cups for center bearing, table base surface, etc. Unit completely sealed against foreign matter.
LOCKING	Two non-influencing locks are provided.
ACCESSORIES	Tail stocks, centers 90° angle plate, hold downs and handle clamps, indexing attachment and index plates.

Consult us or your nearest dealer for further details

Bridgeport MACHINES, INC.
Bridgeport, Connecticut
Manufacturers of High Speed Milling Attachments and Turret Milling Machines



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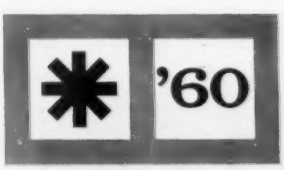

faster changeovers boost press production

Whistler Magnetic Perforating Dies feature interchangeable parts fastened to steel templates which are patterned to the stamping. Punches and dies are assembled and disassembled in templates on an assembly bench while the presses are working on other production.

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GET THE TIME AND MONEY SAVING STORY ON WHISTLER PRODUCTS:
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FOR FAST, LOW COST SCRAP HANDLING

Cooper Weymouth scrap choppers take skeleton strip as it comes from the press and chop it quickly and efficiently into a size that is easily handled and stored for collection. Save time, trouble and space in busy press rooms. Self contained units are fully portable, heads tilt to any desired feed angle. Available in three sizes to handle stock .156 x 5″ or .093 x 12″. Only one moving part; jam proof orbital cutting action.

Inquire about Cooper Weymouth stock reels, part and stock straighteners, mechanical and air operated slide feeds.

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606 Honeyspot Road, Stratford, Conn.

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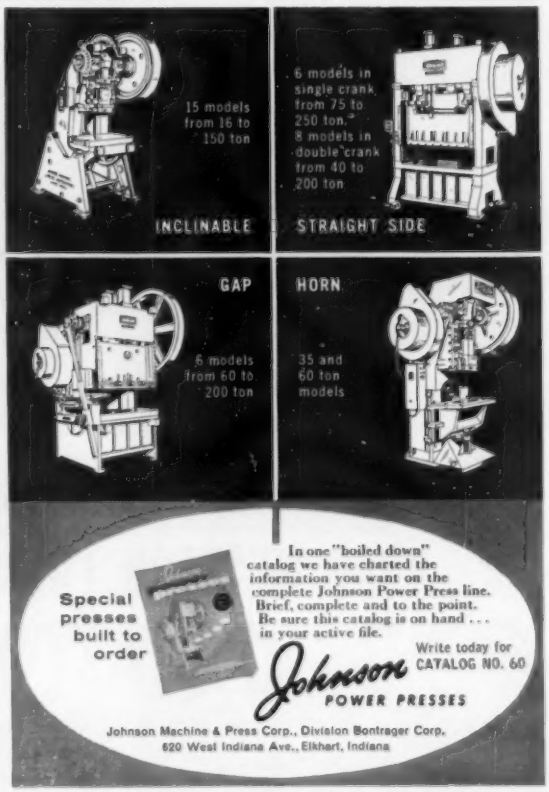
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Always a smooth powerful cut

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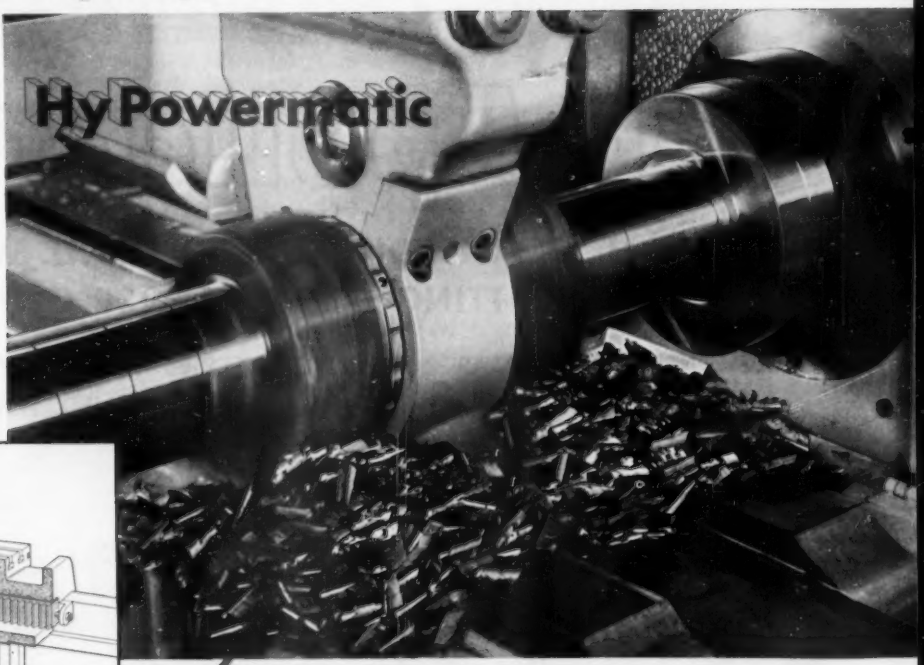

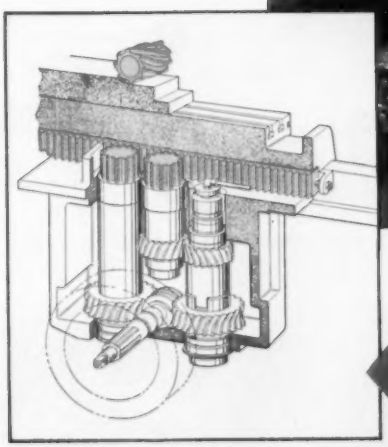

HYDRAMECH TABLE DRIVE *provides maximum driving force, regardless of table travel or bed length . . . consists of hydraulic motor, driving twin vertical pinions that engage table rack.*

. . . with exclusive

HYDRAMECH TABLE DRIVE

For production milling of medium-to-heavy parts CINCINNATI HyPowermatics offer you a number of cost-saving features. One of these is Hydramech, Cincinnati's exclusive table drive unit which applies force exactly where it belongs – *direct to the table, immediately below the cutting force* – not through long leadscrews driving the table brackets. The result is uniformly smooth cutting action on *every* HyPowermatic regardless of size.

Table feeds are infinitely variable up to 150" per minute and can be changed even during milling, by a simple twist of a dial . . . or automatically, with the variable feed attachment. Hydramech Drive also incorporates Cincinnati's exclusive backlash eliminator, which permits both conventional and climb milling operations.

In shops everywhere CINCINNATI HyPowermatics are making unusual production records. The complete HyPowermatic line includes 300 sizes and types from which to choose – 50 sizes each in plain, duplex, tracer controlled plain or duplex, rise and fall plain or duplex. For complete details, write for Catalogs M-1909-3 and M-2020-2. **Milling Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

Booth No. 1034

MMT-PE

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Precision Ground

SOLID CARBIDE TOOLS AND BURS

Job Applications

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RECOMMENDED APPLICATIONS ATRAX "STANDARD" SOLID CARBIDE END MILLS

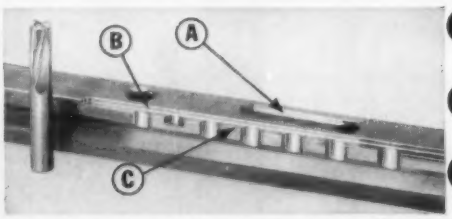
202 different "standard" Atrax Solid Carbide End Mills in 20 different series, each engineered for a specific cutting application and recommended for specific materials.

The most widely used Atrax End Mills and the materials on which they are engineered to perform best are shown in this table:

Material	Series 1501	Series 1502	Series 1503	Series 1504	Series 1505
Carbon Steels					X
Free Cutting Steels					X
Nickel					X
Nickel Chrome					X
Stainless Steels					X
Cast Iron		X	X		
Malleable Iron		X	X		X
Brass and Bronze	X				
Aluminum	X			X	
Zinc Alloy	X				
Copper	X				
Hard Rubber	X				
Fibre	X				
Plastics	X				
Monel Metal					X
Toughened & Heat Treated Steel					X
Hardened Steels					X
Titanium					X
Magnesium	X			X	

X—Preferences

TYPICAL SERIES 1505 PERFORMANCE ON ROCKWELL C-64 HARDENED TOOL STEEL WORKPIECE

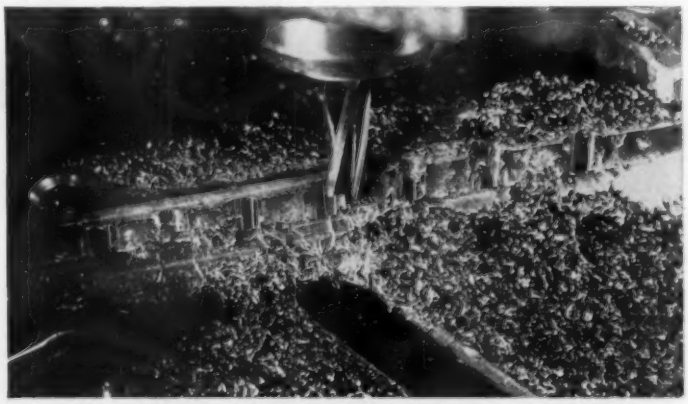


A Elongating ⅜" slot, 1/16" deep at 700 rpm.

B Step cutting 3/16" wide—3/32" deep at 1150 rpm.

C Counter boring at 1150 rpm.

Note high surface finish and absence of burs and scoring. This Atrax ⅜" 1505 End Mill showed no appreciable wear land after completing three operations on this hard-to-cut material.



Note efficient, uniform chips with no burning and no chatter.

AN END MILL FOR EVERY APPLICATION

There is an Atrax "Standard" Solid Carbide End Mill job engineered for virtually every End Milling application. The Atrax Catalog gives engineering data on speeds, feeds, use of coolants and job hints that will further increase tool life production when you specify and use these superior Atrax Tools.

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BATH Tap'n Gage TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 17

Subject: Surface Treatments for Taps:

The basic ingredient in ground thread taps is —

properly selected and carefully heat treated high speed steel.

Many taps are used every day with superior results if the "basic ingredient" is present. These taps are said to have a "bright finish". There are however, four surface treatments (change in surface characteristics) which can improve the performance of taps when used on some applications . . . but none will compensate for improper selection and treatment of the basic metal. These processes are NITRIDING, STEAM OXIDE, NITRIDING plus STEAM OXIDE and PRECISION CHROME PLATING.

Nitriding

In this process, the taps are immersed in a cyanide salt bath in the range of 1000°F-1050°F for a specified time. This produces a case or surface which is appreciably harder than regularly treated high speed steel. This surface resists abrasion and has good lubricant retaining properties, increasing wear life in abrasive materials and reducing galling or metal pick-up. Nitriding may cause brittleness and is not recommended for small diameter machine screw taps or in tough materials where chipping may be a problem.

Steam Oxide

Bath applies this treatment by use of the Steam Homo process. The taps are heated to the 1000°F-1050°F range in the presence of steam for a specified time. This produces a black oxide surface which has good lubricant retaining properties; reducing galling and metal pick-up. The additional tempering of the process relieves grinding stresses which helps to prevent chipping and improves toughness. It is particularly helpful on some taper pipe tap operations.

Nitriding and Steam Oxide

This treatment is a combination of both processes with nitriding usually applied before steam oxide. Under certain conditions the plus factors of each treatment will be obtained. Quite often if taps with nitriding chip... the condition can be mitigated by applying steam homo.

Precision Chrome Plating

(Bath Kromolloy)

This is a special process for accurately depositing hard chrome plate on taps. This surface deposit which resists abrasion, is effective in some grades of stainless steel and certain plastics. It is helpful in preventing galling and pick-up in copper, brass and bronze.

A surface treatment can be beneficial or detrimental depending on the tapping application. Let a Bath threading engineer recommend proper taps for your specific tapping problems. Contact him through your Bath distributor — or write direct.

• Cylindrical and Thread Gages • Ground Thread Taps • Internal Micrometers John BATH & Co., Inc.

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Want to *eliminate* tap breakage, burring, jig and fixture movement, time and valuable part losses?

Mohawk Standard Drill-Chamfer sublands can do just that for you—plus, the obvious benefit of clean, concentric chamfered holes that will speed tapping operations, increase tap life, improve accuracy and lower both drilling, tapping and scrap costs. Yes, these "standards" drill and chamfer simultaneously. They're faster, infinitely accurate, they outlast *ordinary* tools and remain positively concentric through repeated regrinds.

And—they're easy to select for any job, because Mohawk (and their distributors) stock all practical sizes in 3 step lengths and 3 shank styles for immediate deliveries.

Subland Drill-Chamfer for Regular Taps Fluteless Taps Pipe Taps Heli-Coil® Taps

Subland Drill Counterbore for Socket Head Cap Screws

Subland Drill-Drill for Tap Drill and Body Clearance

Remember, too— Mohawk Standard Sublands are also immediately available in Drill-Counterbore and Drill-Drill types—in all practical sizes, step lengths and shank styles.

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Montpelier, Ohio

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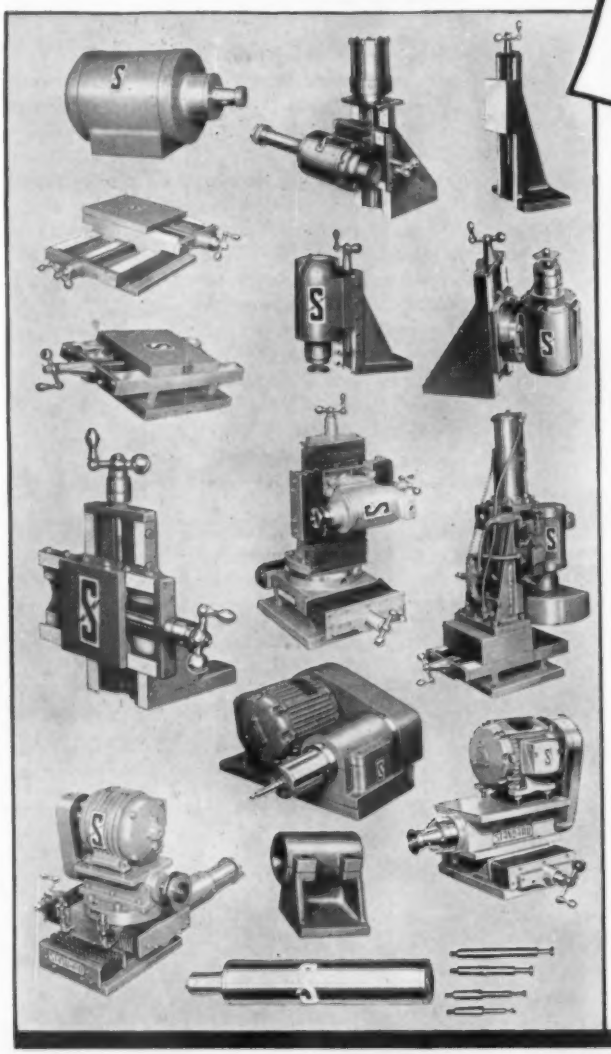

That's the Standard "Building Block" method of special machine design ... simple as that, a Standard Super Precision spindle to mill, drill, grind or bore the work ... coupled with the right Standard slides, feeds or swivels to either bring the spindle to the work or the other way 'round.

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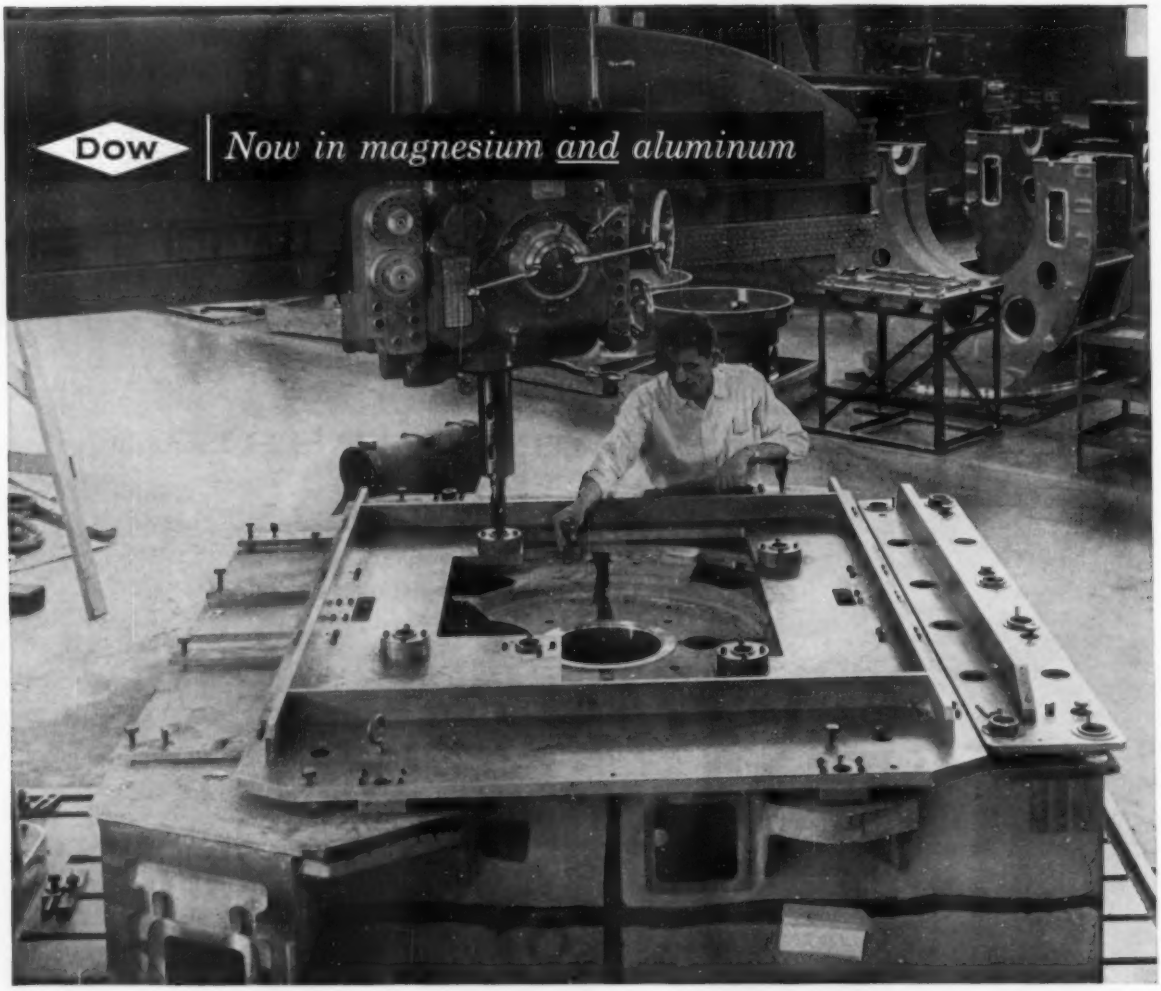


TOTEABLE MAGNESIUM HELPS TOOL HUGE NIKE ANTENNA

"We're using more and more magnesium tooling plate in our shop because it's lightweight, easy to machine and has a superior finish," says the Director of Engineering of Steel Products Engineering Company Division of Kelsey-Hayes.

Light Weight. "We use magnesium tooling plate to make jigs and fixtures of various sizes up to seven feet square in our work on the huge Nike-Hercules antenna," he said. "The largest magnesium tools can be transported with a small lift truck, leaving our overhead crane free for other duties. Many of the magnesium tools can be handled easily by one or two men."

Machinability. "The excellent machinability of magnesium is very important since many operations must be performed to get the two sides of our jigs and fixtures parallel to .001."

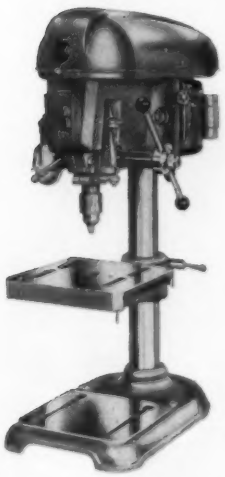
Dimensional Stability. "Magnesium's dimensional stability allows us to hit milling and drilling tolerances on the finished antenna parts of .0002 to .0005."

NEW Magnesium Tooling Plate Manual covers shop working characteristics, properties, design. Contact the Dow sales office near you or write to THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Department 1030FJ8.

DOW **THE DOW METAL PRODUCTS COMPANY**

Division of The Dow Chemical Company

Cuts drilling time by 60%



Delta 15" Drill Press, also 20", 17", 14" and 14" Super-Hi Sensitive. Available in floor, bench, and multiple spindle models.

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Delta drill presses have set the industry standards for years —they cost less to buy, less to operate and less to maintain. Visit your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages)—choose the tool to fit *your* needs from the world's most complete line. For FREE Delta Industrial Catalog showing 61 machines, 302 models, over 1400 accessories, write: Rockwell Manufacturing Company, Delta Power Tool Division, 620H N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

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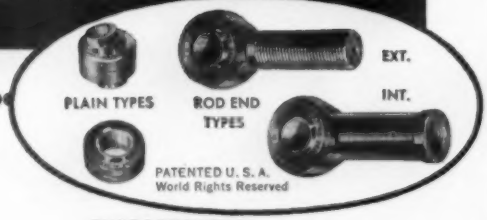

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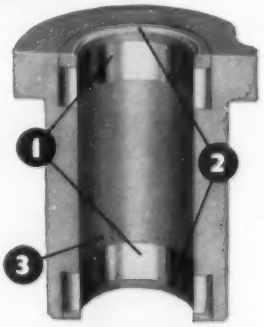

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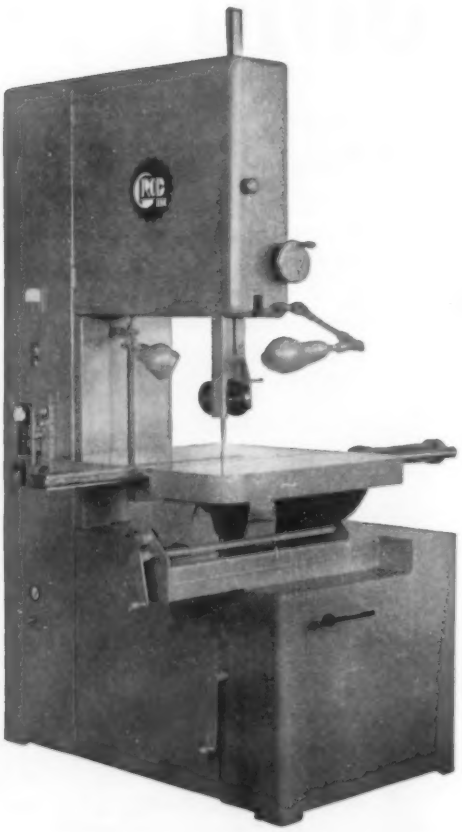

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NO. 132-01 MIKRON SPUR GEAR HOBBING MACHINE

Ask for our Bulletin RH-132-01 which describes the new MIKRON 15-Second Spacing Accuracy Machine.

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue
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2840 Supply Avenue
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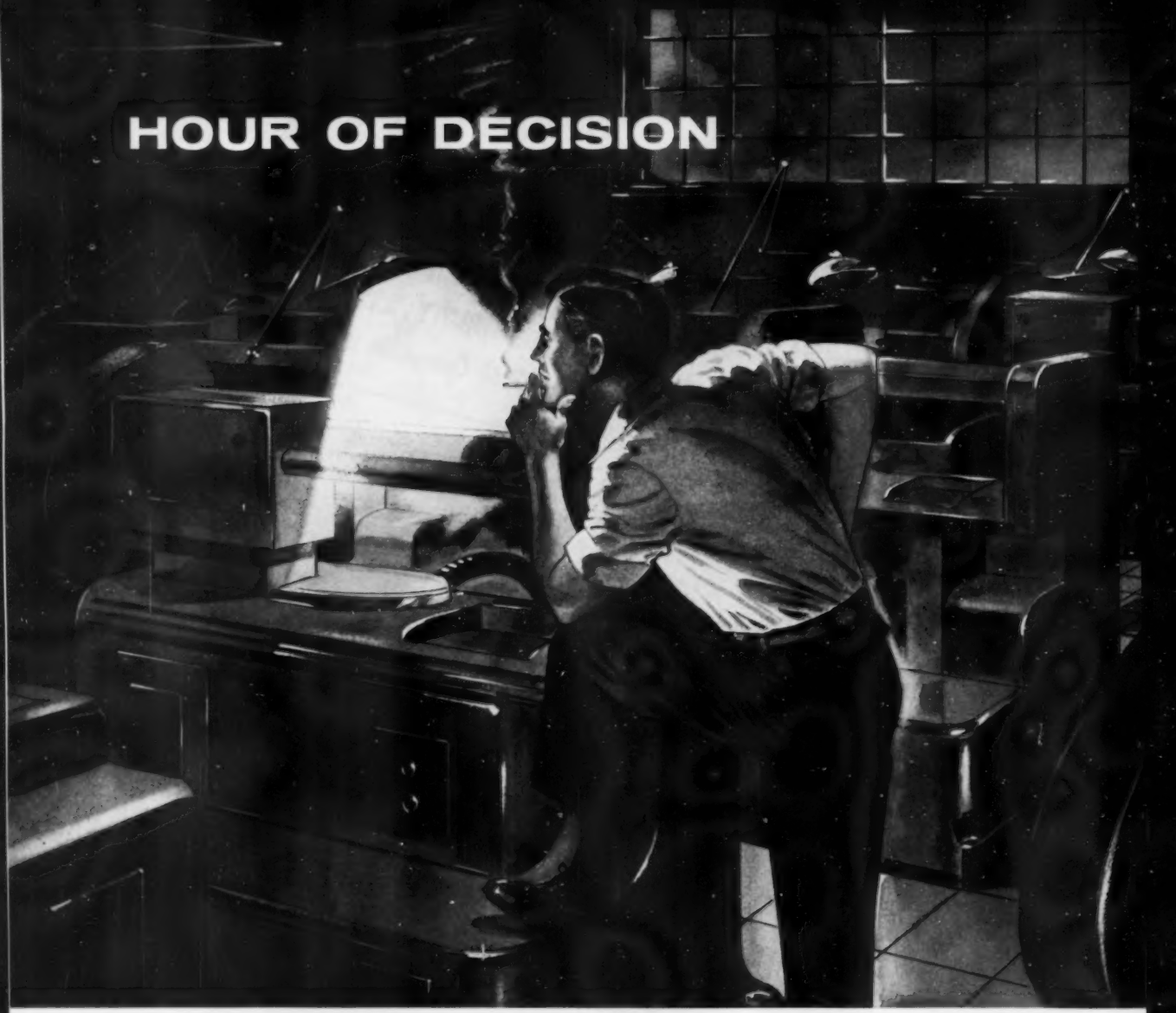
HOUR OF DECISION



IS THIS YOU? How many times, after the call bell stops clanging, the customers stop phoning, and people stop asking questions, do you walk into the quiet shop to face up to the really vital decisions?

"How can we compensate for the rising costs of materials, overhead, payroll, maintenance?" "How can we keep producing the exacting tolerances, finishes, and quality our markets are demanding?" "How can we improve our production efficiency so that our narrow profit margin will not disappear altogether?" "How can we meet and beat the increasing world-wide competition in our field?"

One proved answer to these questions is the logical replacement of obsolete, inefficient machines. THE MACHINE TOOL EXPOSITION — 1960 will back up this fact with 11 acres of the latest developments in machine tools. Can you afford to miss seeing new, faster machine tools that will produce more efficiently . . . new, better methods that will cut satisfying chunks out of metalworking costs . . . new, ingenious ideas that will help you produce more quality for less cost?

Tool-up for the Sixties. Plan *now* to attend the largest, single-industry exposition ever held in the United States. Have your key personnel on hand, too. It's a once in five years chance to examine the latest technological advancements in automation through numerical controls and see why Modern Machine Tools = Production Efficiency!

Also see the PRODUCTION ENGINEERING SHOW on the Navy Pier. One registration covers both.

FORMULA FOR TOMORROW

MODERN MACHINE TOOLS MMT=PE PRODUCTION EFFICIENCY

International Amphitheatre
Chicago, Illinois
Sept. 6-16

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THE MACHINE TOOL EXPOSITION — 1960

For information write to

NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

2139 Wisconsin Avenue, N.W. • Washington, D. C.

Our high speed steels are for performance

– exactly suited to your needs!

Whatever the major problem of the tool application—be it abrasion, impact, high temperature or other prevailing condition—Vanadium-Alloys has a *first quality* High Speed Steel grade to take it in stride. For the performance you need on the jobs you have, it's V-A all the way. Use the experience of our sales engineer in your district—his recommendations can make money for you!

Write for Data Sheets

Our 50th Year—

1910–1960

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VASCO SUPREME: Highest hardness, highest wear resistance, supreme in the field. (U. S. Pat. 2174286.)

NEATRO: Resistance to abrasion exceeds all steels except Vasco Supreme. Excels for both heavy and light cutting.

VAN CUT: High carbon, high vanadium. Properties intermediate between Vasco M-2 and Neatro for easier grinding. Suitable for all types of cutting tools.

RED CUT SUPERIOR: The nation's best known general-purpose steel. Readily fabricated and heat treated. Shines in a host of applications.

VASCO M-2: The original 6-6-2 type steel. Wide hardening range, good machining characteristics, outstanding economy in service.

8-N-2: Low tungsten, high molybdenum, very tough at high hardness. Excels for fine edged tools.

VAN-LOM: High molybdenum, high vanadium. Best cutting performance of all high molybdenum steels.

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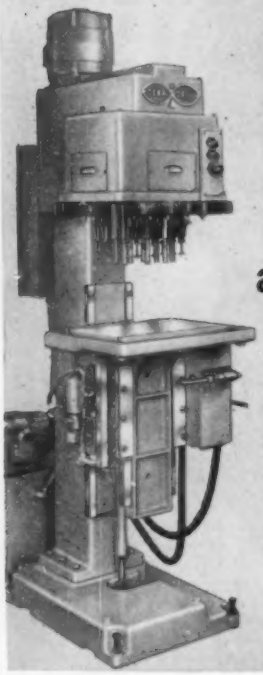
DEKA DRILL



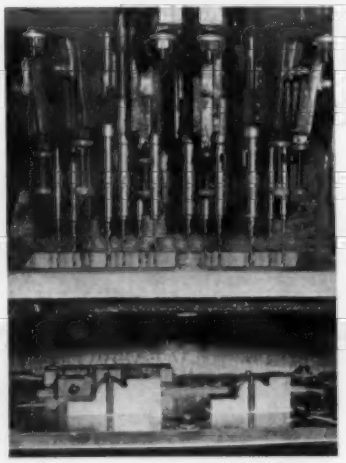
HYDRAULIC MULTIPLE SPINDLE DRILLING and TAPPING MACHINE

Send us one of your drilling or tapping problems for a free time study estimate. Find out how automatic cycle drilling and tapping with DEKA-DRILL can increase production and save time and money for you!

A DEKA DRILL CASE HISTORY

TWO COMPLETE CASTINGS IN 12 SECONDS!

COMPANY: Kleinschmidt division of Smith-Corona Marchant.



OPERATION: Drills three .156 holes 1¼" deep and two ¼" holes 1¼" deep through aluminum extrusions.

TIME OF COMPLETE OPERATION: 12 seconds. Floor to floor—37 seconds!

TECHNIQUE: Nest plate consists of six stations. First and second stations drill three .156 holes 3/8" deep. Parts are turned over 180° in third and fourth stations and new parts placed in first and second stations and three .156 holes are drilled through. Parts completed by drilling two ¼" holes through piece in same manner in fifth and sixth stations. Parts are clamped automatically during drilling cycle by 12 pressure pads on bushing carrier mounted on top leaf of Master Die Set fixture.

PRECISION TOOL AND MFG. CO. of ILLINOIS

DEPT. TE-6 1305 S. LARAMIE AVENUE, CICERO 50, ILLINOIS

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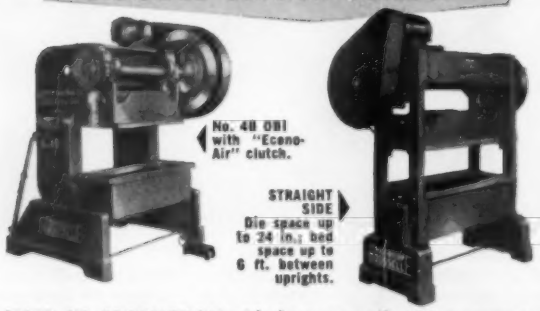
High Output with ROUSSELLE

DOUBLE-CRANK PRESSES



No. 48 OBI with "Econo-Air" clutch.

STRAIGHT SIDE Die space up to 24 in.; bed space up to 6 ft. between uprights.

SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.

Choice of over 30 models and types in 5 to 60-ton sizes

SERVICE MACHINE CO.
Mfrs. of Rousselle Presses
3310 WEST 78TH ST. • CHICAGO 20, ILL.

Rousselle Presses are sold exclusively through Leading Machinery Dealers

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DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

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TRIED • PROVEN • GUARANTEED
MICRO MINIATURE END MILLS

2 Flute 1/32 through 3/16 by 1/4S
3 & 4 Flute 3/32 through 3/16 by 1/2S

ALL SIZES SINGLE AND DOUBLE END

2 and 3 Flute Flat or Ball End—4 Flute Flat End Only

STUB LENGTH IN ALL SIZES

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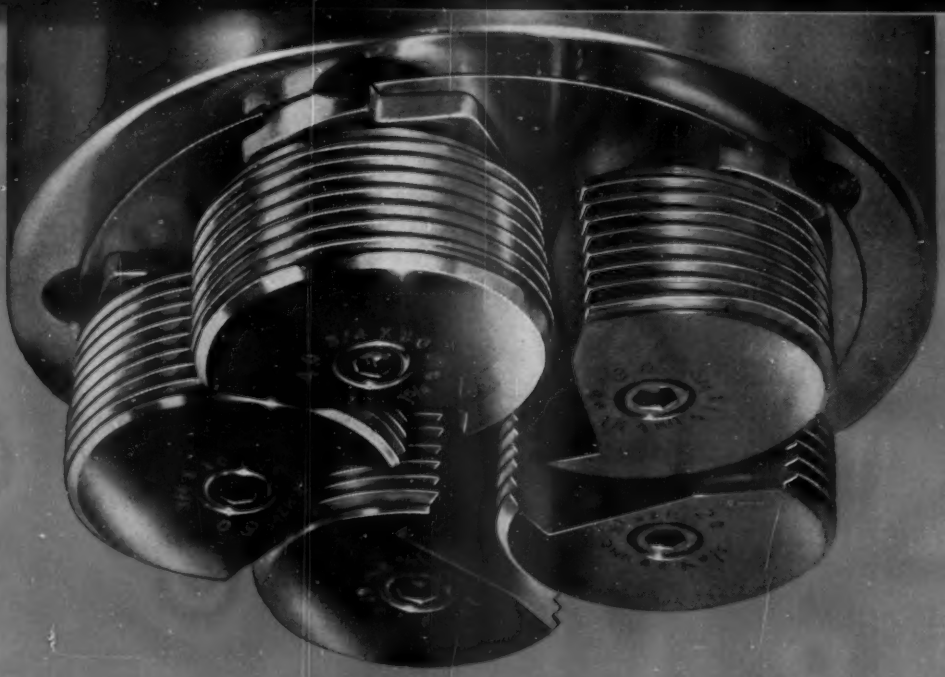

RIDGID® reports on the 5-Chaser Vers-O-Tool

Ups pieces-per-grind from 200 to 3000!

Here's more startling evidence of how NAMCO 5-Chaser Vers-O-Tools pay off in increased threading efficiency. States Horace Ives, Automatic Machine Foreman at Ridge Tool Company, manufacturer of famous RIDGID pipe tools, Elyria, Ohio: "Since switching to a NAMCO 5-Chaser Vers-O-Tool for threading our Nipple Chuck adaptor, we get consistently accurate threads at lower cost. Pieces-per-grind have increased from 200 to 3000; set-up and change-over time is hours less. And, because we get our required Class 2 thread *every time*, scrappage is practically non-existent." These are common comments from users of NAMCO 5-Chaser Vers-O-Tools. In your shop, too, they'll give threading efficiency you never believed possible. Call, write or wire for complete information.

National Acme

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193 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

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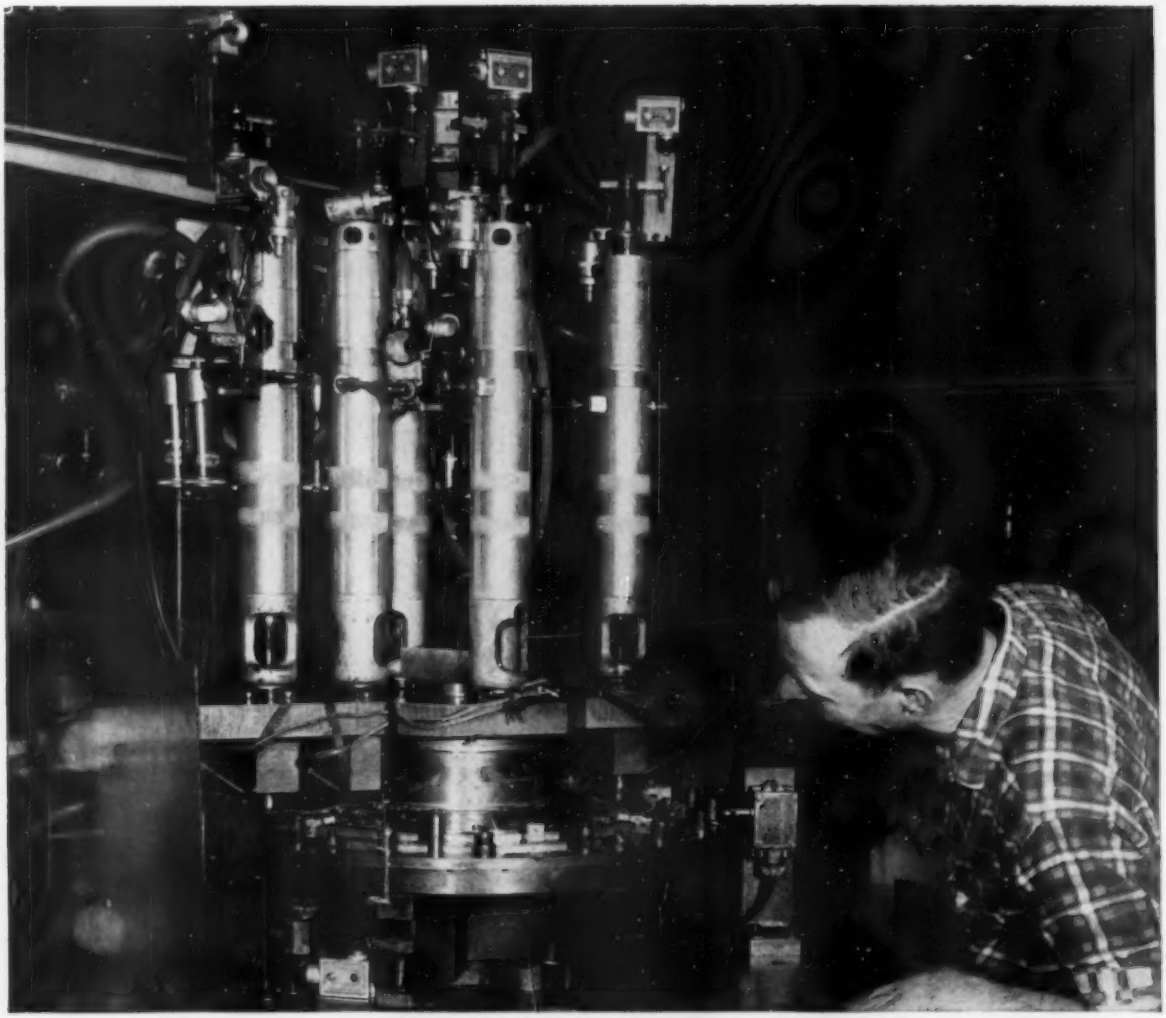


Automatic drilling operation performed at Hupp Aviation Division, Hupp Corporation, Chicago, Illinois.

Airfeedrills® cut drilling time 88% on jet aircraft part

Time required for drilling 104 holes in a bearing support for a jet aircraft compressor was cut 88% when the manufacturer switched from other methods to five Gardner-Denver "Airfeedrills."

Three bolt circles were drilled at two different levels; 72, 8 and 24 holes were drilled in bolt circles 18⅞", 10.2" and 8.5" respectively. All holes in the material—AMS-6415—were drilled to close Air Force tolerances. A 36-station index table, plus automatic "Airfeedrill" controls, automated the entire operation.

VERSATILITY AND INTERCHANGEABILITY

This is just one more example of the versatility and interchangeability of Gardner-Denver "Airfeedrills." They're easily adapted to almost any drilling setup. You mount them as a drilling unit of 2, 20 or more spindles for automatic hole processing. Use one as a stationary drill mounted on an inexpensive fixture. As a portable drill, "Airfeedrill" hangs by its nose to a jig for precision drilling.

See for yourself how quickly and inexpensively you can automate *your* drilling operations . . . see your Gardner-Denver representative or write for Bulletin 92-1 on "Airfeedrill" specifications and applications.

GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

With the A-L Steelector System

How can you pick the right tool steel when there are more than 1000 brands, each jostling for your attention? And how can you pick a tool steel and know before you order that the grade you want is available—without delays—in the size and shape you need?

If you are tired of wrestling with these problems you will like the new Allegheny Ludlum Tool Steel STEELECTOR Program. With it you can accurately select a tool steel that will meet your requirements and be sure that you have picked a grade that is in stock . . . as near as your warehouse source.

It's easy to make accurate selections with the STEELECTOR Program. The three STEELECTOR cards—covering general purpose tool steel applications, hot work applications, and high speed grades—show at a glance the comparative properties of tool steel grades that will suit 96% of all tool steel applications listed in the A-L Tool Steel Handbook.

The STEELECTOR cards use bar graphs to make it easy to make precise comparisons of abrasion resistance, toughness, size stability, machinability, and red hardness. All you have to do is pick the grade with the particular combination of properties you need for the job at hand.

For each grade, there is a Data Stock List that tells you the exact analysis of the grade, its basic properties, typical applications and their working hardnesses, and temperatures for hardening, tempering, and annealing. And the complete range of available sizes and shapes is listed.

You can count on getting quality tool steel by using the STEELECTOR Program. Each STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the exacting quality control standards of all A-L products.

The new A-L Tool Steel STEELECTOR booklet contains the STEELECTOR Cards, descriptions of the various grades, and explains the individual Data Stock Lists available for every grade. For your own copy ask your Allegheny Ludlum sales representative, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. TE-8.***

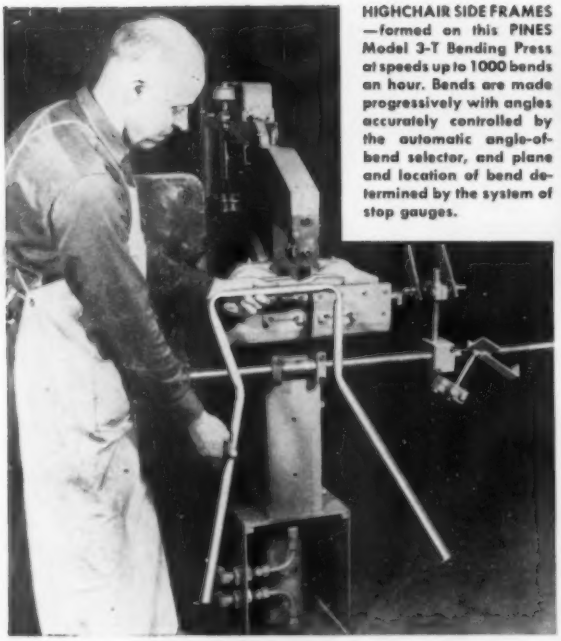
STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

AL

2084



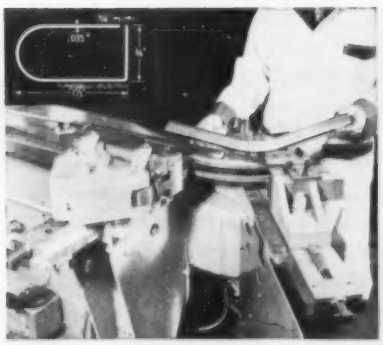
HIGHCHAIR SIDE FRAMES—formed on this PINES Model 3-T Bending Press at speeds up to 1000 bends an hour. Bends are made progressively with angles accurately controlled by the automatic angle-of-bend selector, and plane and location of bend determined by the system of stop gauges.

A DIFFICULT ALUMINUM EXTRUSION BEND—Preventing distortion and warping was difficult in making this 90° bend in 6063-T6 aluminum on a 9¾" inside radius. A split-type bending die and link mandrel, on a Model 2 machine, produced wrinkle-free bends with no distortion.

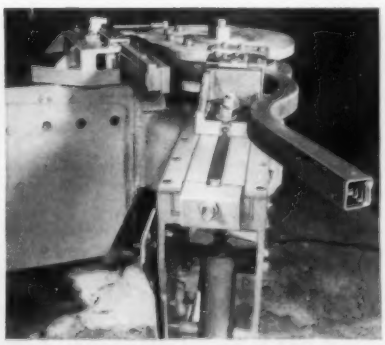
COLD BENDING
THE PINES WAY
Can Help You Remain Competitive

• High-quality bends at high speed is the key to a favorable competitive position in the fabrication of extrusions, tubing, pipe, or rolled sections. And the PINES WAY of bending is the key to quality and speed. It includes superior design, tooling to suit the job, provisions for quick setup, and competent service.

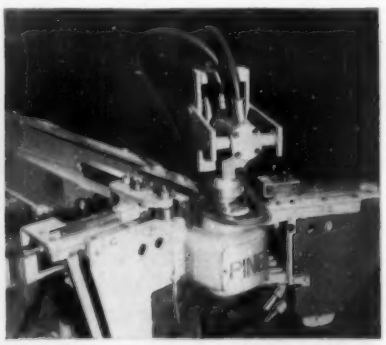
Some examples of the results of these factors are illustrated here. Whatever your metal-forming needs may be, it will pay you to investigate bending the PINES WAY. For assistance on your jobs or a cost analysis, call on Pines without obligation.



D-SHAPED STEEL CHANNEL—Unique tooling permits edge-bending without closing the ⅛" slot. 37° bends are made on a 9" inside radius to form side rails for playground slides. Done on a Model 1¼ Bender.



SQUARE-TUBE VEHICLE FRAMES—Bending of SAE 4140 steel tubing, 3" square x .239" wall on 10½" radius is done on this Model 4 Bender. Tooling illustrates use of compound die for clamping on bent section.



FLAT STEEL BARS—Three ⅜" x 1" bars are bent in one operation to 160° on this Model 1 Bender. A split die actuator opens the dies for easy removal of the pieces. Bends are smooth and wrinkle-free.

PINES ENGINEERING CO., INC.

Specialists in Tube Fabricating Machinery

693 WALNUT • AURORA, ILLINOIS

SEE US AT BOOTH 266-68

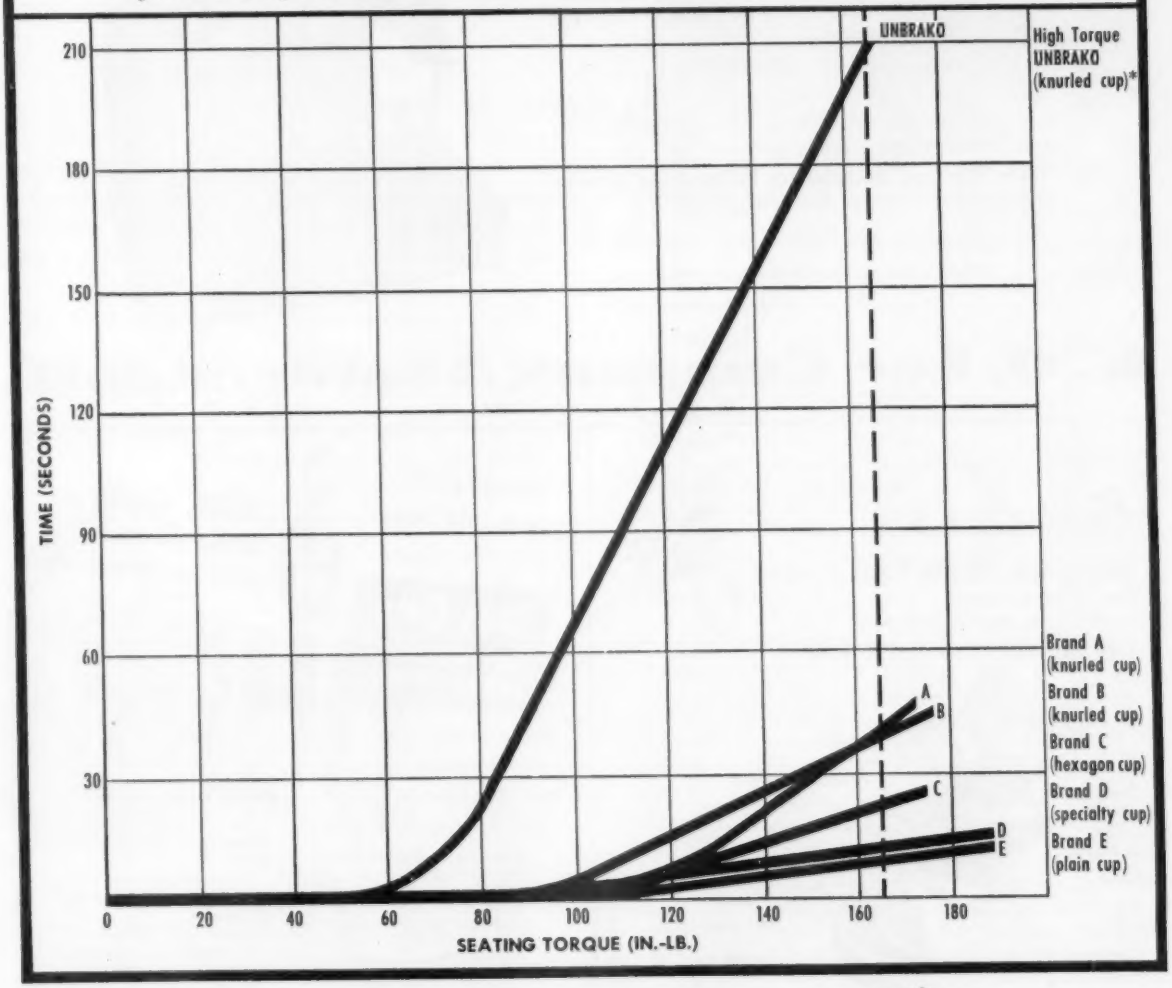
PRODUCTION ENGINEERING SHOW SEPT. 6-16 1960 NAVY PIER, CHICAGO

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY

What else is there to say?

HOLDING POWER UNDER IMPACT-INDUCED VIBRATION

$^5/_{16}$-18 x $^5/_{16}$ Socket Set Screws (1750 cycles per minute)



*Standard . . . and at no extra cost!
For size range and price information, contact your local UNBRAKO distributor or write Standard Pressed Steel Co., Industrial Fastener Division, SPS, Jenkintown 37, Pa.

SPS

where reliability replaces probability

Announcing the NEW! K.O. Lee SURFACE GRINDER

Model S612H

features:

- ★ A low cost precision grinder designed to handle most of the work ordinarily done on larger machines.
- ★ Spindle has duplex pre-loaded heavy duty ball bearings on each end. Spindle is driven with O-ring type belts for smooth operation.
- ★ Heavy cast iron construction throughout.
- ★ Extra length V and flat table ways distribute weight over greatest practical area for maximum table support and permanent accuracy.
- ★ Table Ways are continuously lubricated, a definite improvement over the one-shot system.

Finest accuracy and micro-finish obtainable.

WRITE FOR COMPLETE LITERATURE

K.O. Lee Company, Aberdeen, S.D.

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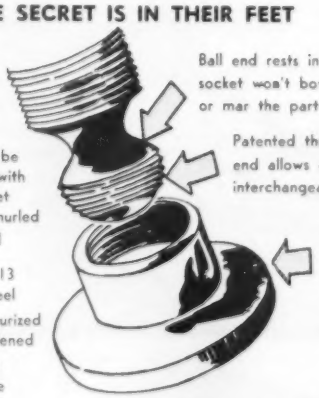
Track Champions and

CARR-LANE SWIVEL FOOT SCREWS

have a lot in common . . .
besides being tops in their field

THE SECRET IS IN THEIR FEET


Ball end rests in socket won't bow or mar the part
Patented threaded end allows easy interchangeability
Three different foot designs
SIZES from 1/4-20 to 5/8-11 Many lengths
Can be had with Socket or Knurled Head
1113 Steel
Carburized Hardened
Black Oxide Finish

This is just one of the superior Carr-Lane components . . . Get your copy of our latest Catalog

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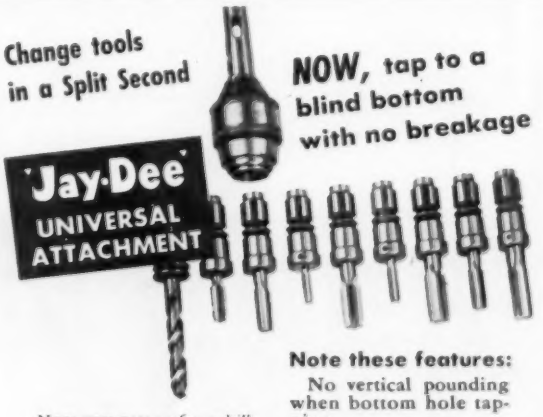
Change tools in a Split Second

NOW, tap to a blind bottom with no breakage



NOW YOU CAN perform drilling, reaming, spot facing, and stud driving operations in quick succession, simply by snapping adapters into the versatile Jay-Dee Universal Attachment.

No adjustments are necessary, since the Jay-Dee allows you to tap any size hole within its capacity.

The Jay-Dee CUTS COSTS by eliminating tap breakage—and by speeding up operations.

Note these features:

No vertical pounding when bottom hole tapping
No tap breakage
Same tap adaptors for all metals
Short body lengths
Virtually no working parts to go wrong
No springs or ball races to wear out
Split-second tool changes
Pre-determined tapping torque

Literature sent upon request

FEDERAL-BRYANT MACHINERY COMPANY

4639 Washington Boulevard, Chicago 44, Ill., ESTebrook 8-3307

A few desirable distributorships available

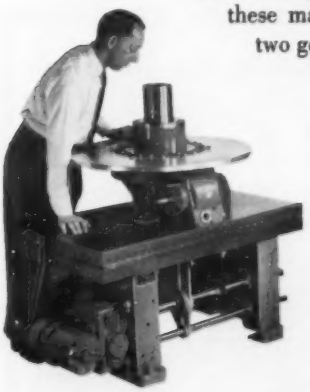
Use Reader Service Card, CIRCLE 117

America's finest automatic transfer machines now available to outside companies!

You know Sylvania for light bulbs, radio tubes, fine electronics equipment. (You also know how exacting specifications have to be to make such fine products on automation machinery.) Over 20 years ago Sylvania discovered there were no transfer machines available to meet our unusual standards of required accuracy. To get the exceptional machines we needed, we had to make them ourselves. We have been doing it ever since.

Now these machines are available to outside companies seeking this same extraordinary degree of accuracy.

Ideal for high-speed automatic fabricating, finishing, assembling, indexing, packaging, these machines are available in two general types:



1. Rotary indexing chassis in two sizes and in single and double turret models. Made with unusually great driving and tool capacity. Note: top of transmission spider is specially machined for rotary vacuum or pressure valve.

2. Conveyor indexing chassis, exceptional for the extreme accuracy, strength and versatility of its chain—not made commercially, but by Sylvania itself. You also get greater tool and driving capacity than in other such chassis on the market.

Also, precision indexing transmissions (5 models)

- **Heavy-duty unit** with extra-large cam well and spider diameter for wider range of stops per revolution.
- **Standard unit** features higher cam speeds, a provision to integrally mount rotary vacuum or pressure valves.
- **Universal unit** operates with its output shaft horizontal or vertical. Has wide range of applications.
- **Small universal unit.** Lower silhouette and extra-long input shaft are main features of this extremely durable, accurate transmission.
- **Conveyor unit.** Very rugged, heavy-duty unit designed for conveyors, but easily adaptable for rotary tables, other intermittent motion machines.

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SYLVANIA LIGHTING PRODUCTS
Equipment Development Plant
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Please send me free brochure of:
☐ ROTARY ☐ CONVEYOR ☐ TRANSMISSIONS

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Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

ANOTHER REPORT FROM THE ALMCO ALBUM OF NEW PRODUCTS

To know what's new in Barrel Finishing

Keep Your Eye on ALMCO!

The right machine, the right method, the right media . . . that's the basis for planning any ALMCO *Supersheen* System. And a continuing program of research, ever seeking even better barrel finishing . . . that's the secret of ALMCO progress in making metal finishing easier, faster and finer . . . and more profitably productive for you. Shown below are typical recent developments that give concrete meaning to the phrase, "*To know what's new in barrel finishing, keep your eye on ALMCO!*"

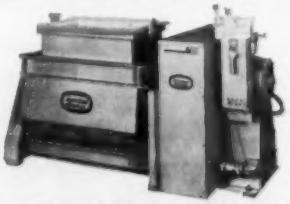
New Spindle Machine

For precision finishing of complex high-quality components such as gears, bearing cages, spline shafts, pump rotors, jet blades, etc., on a continuous production line basis. Large parts or clusters of smaller parts are chucked directly to spindles from single operator's work station. Spindles lower parts into high velocity stream of abrasive media contained in tub that rotates at controlled speed. Spindles themselves also rotate while in the abrasive stream, uniformly exposing parts to the abrasive stream. Indexing head slowly carries all spindles in 1 to 9 min. trip around the tub. All surfaces get the same amount of precision finishing.

Models available with automatic or manual indexing, 2 to 16 spindles, tub diameters of 48" to 90", and drives of 5 to 30 hp.

New ALMCO VIBRASHEEN

The new *Vibrasheen* method is particularly suited for faster burr removal from parts and finishing hard-to-reach internal crevices. This amazing metal finishing machine vibrates a full 5 cu. ft. load of parts and media . . . uses scrubbing action to remove burrs and finish parts in a fraction of the time needed in ordinary operations. Smaller and larger models also available.



Container pivots 120° to facilitate loading and unloading.

ALMCO *has the right New* BARREL FINISHING EQUIPMENT *for you!*

New ALMCO Roll Barrels

One man operates entire Roll Barrel System. Makes low-cost precision barrel finishing available to any deburring and finishing department! Ideal for finishing large variety of small lots of parts.

New Barrel Finishing Compounds

No. 407. An alkaline powdered composition used in cleaning, brightening and grinding ferrous parts.

No. 408. A very fine silica flour base powdered abrasive grinding compound for use with all metals and alloys. Provides ultra-low micro-inch finishes.

No. 410. An alkaline compound for one operation light deburring and color cycles on ferrous metals.

No. 412. A highly concentrated burnishing compound with tallow and oil soap base for use on both ferrous and non-ferrous metals.

No. 501R. A concentrated mild alkaline compound to inhibit rusting of all ferrous metals. Retains high burnishing finish.

43 other *Supersheen* compounds, plus a complete line of media, are also available from ALMCO. Ask how you can enjoy quantity discounts with the ALMCO Blanket Order Program! Start saving today!

ALMCO

QUEEN PRODUCTS DIVISION
King-Seeley Corporation
188 E. Main St.
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Free!

ALMCO ALBUM OF NEW PRODUCTS

For the full story on the right machine, the right method, and the right media, write today for your FREE copy of the complete and highly informative ALMCO Album of New Products!

YOUR SAMPLE PARTS PROCESSED without obligation in a nearby ALMCO test lab! Simply write on letterhead for address of nearest ALMCO lab or send parts direct to Albert Lea, Minn. Enclose specifications desired. Complete free report includes detailed recommendation giving machine, method and media proved in the lab to be exactly right for you! No obligation, of course.

Designers and Builders of All Types of Barrel Finishing Systems for the Metal Working Industry

WHY NICE...

NICE offers Product Designers . . .

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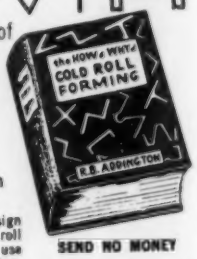

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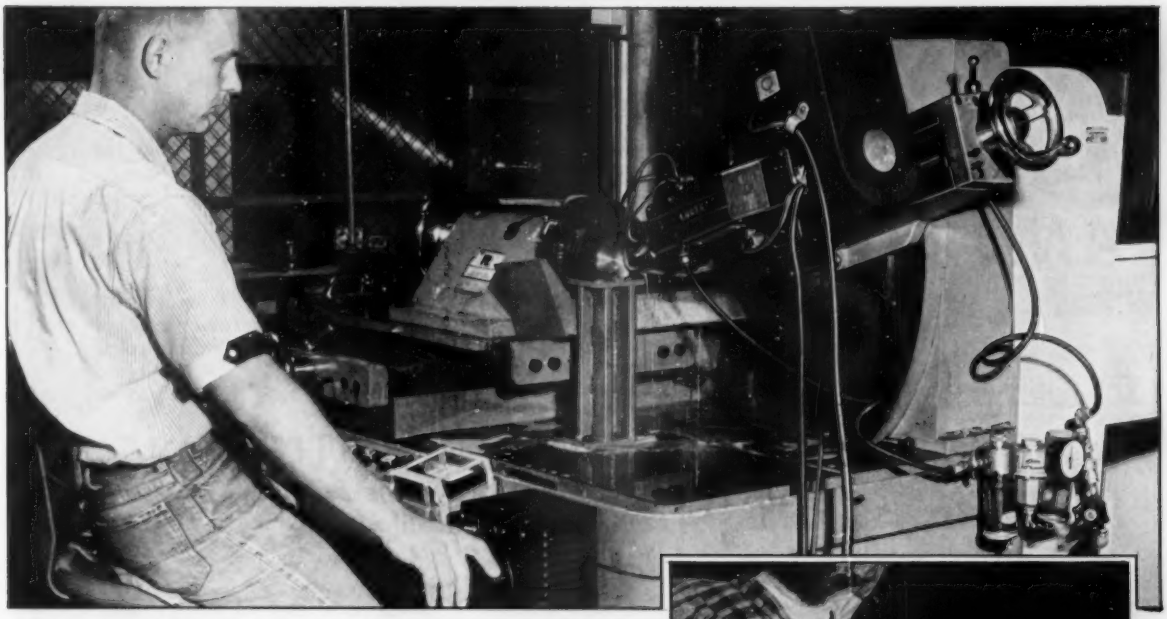
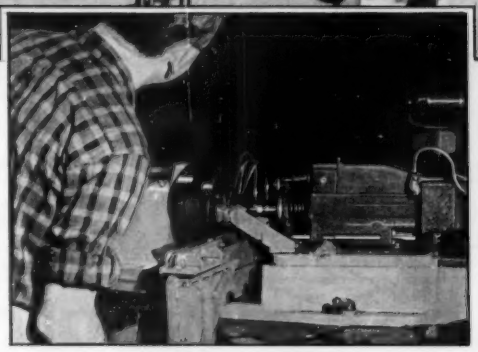


This special machine at Rocketdyne is designed so that angular adjustments of Bellows-Locke Drilling unit can be made in a vertical plane. Also visible is the Bellows Lubri-Air® Control unit (right) which cleans, lubricates and regulates the air supply.



This machine is similar to the one in the main illustration, except that the Bellows-Locke Drilling unit is mounted in a horizontal plane. Work-holding fixture also indexes on horizontal axis. Between the two machines, any angular relationship between two or more holes can be produced.

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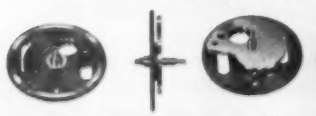

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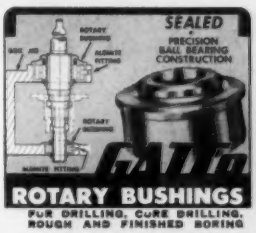

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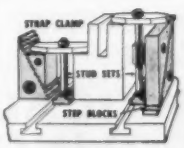

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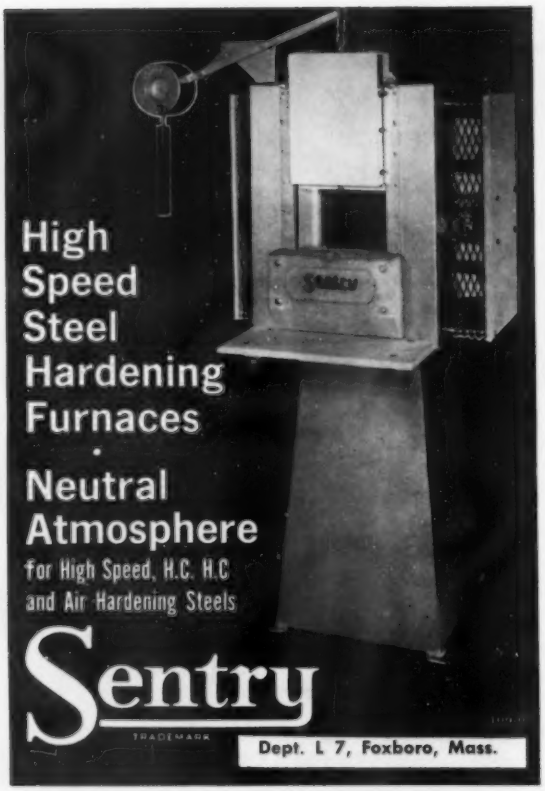

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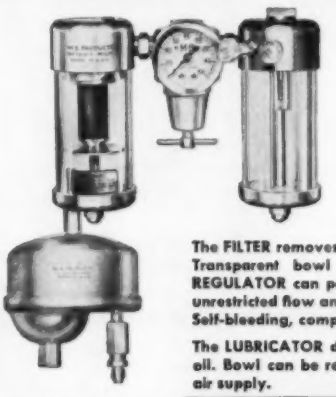

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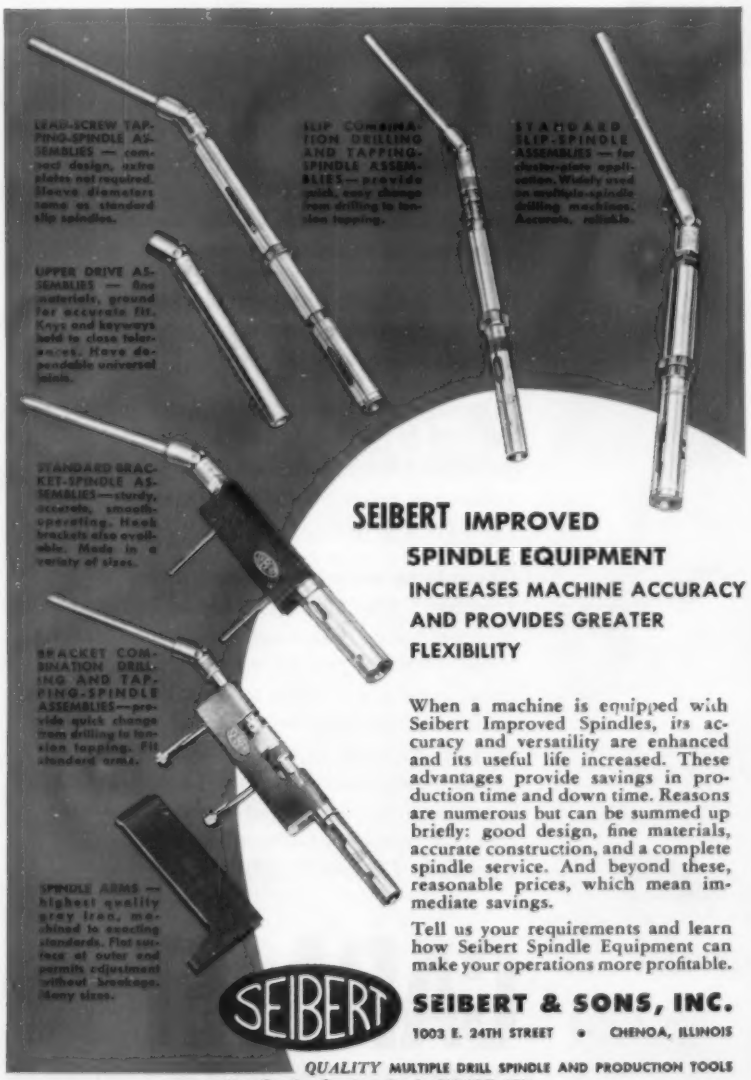
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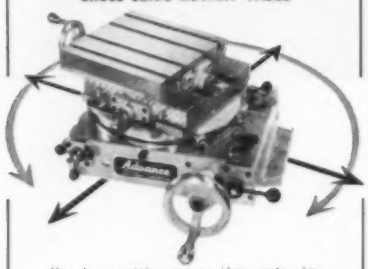

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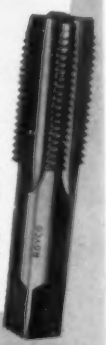

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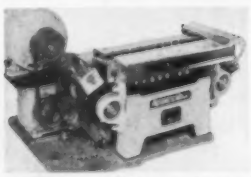

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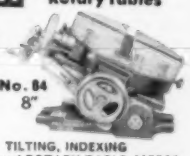

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Results of a survey entitled "Engineering Professionalism in Industry" show that there is a major lack of two-way communication between engineers and managers. The survey, based on interviews conducted by the National Society of Professional Engineers, disclosed that 90 per cent of the managers questioned regard engineers as among the employees making the most valuable contribution to the company. Less than half of the engineers felt that they were so regarded by management.

Other findings: Sixty-one-percent of the engineers employed in industry think there is considerable mal-utilization of engineers, but only 30 percent of industrial managers agree. More than half the engineers feel that higher salaries would advance the engineering profession. Only 20 percent of industrial managers agree.

Starting salaries for engineering graduates have risen to a new high. Lehigh University June graduates reported average starting salaries of $510 for industrial engineers, up $18 from last year. Mechanical engineering graduates started for an average $528, up $32 from last year. The biggest gain, however, was registered by arts graduates, who started for an average of $420 last year, $498 this year—an 18 percent boost.

An experimental electrolytic gas cell generating an oxygen-hydrogen mixture is a promising fuel source for explosive metal-forming operations and high-temperature welding and cutting torches, according to scientists at Battelle Memorial Institute.

When exploded, the gas mixture creates pressure 10 times greater than the starting pressure, which is limited only by the strength of the container. For example, a 1500-psi mixture on a 2000-sq in. working surface would produce a force of 15,000 tons when ignited.

Using gas for explosive forming may have some advantages over present methods, says Battelle's Dr. John McCallum. The shock wave of a gas explosion rises to a peak within several milliseconds, then tapers off gradually. When solid or liquid explosives are used, shock waves go to high levels almost instantaneously, remain there for a few seconds, then drop abruptly. This wave pattern, unlike the patterns caused by waves from a gas explosion, may cause parts to crack.

Practically all the controls used in conventional ultrasonic cleaners are eliminated in a new type of cleaner developed by Powertron Utlrasonics Corp. A feedback transducer measures the amount of ultrasonic activity in the cleaning tank and corrects output phase and frequency to maintain the standing wave condition. Consequently maximum cavitation—the "cold boiling" on which all ultrasonic cleaning is based—is maintained automatically for all conditions.

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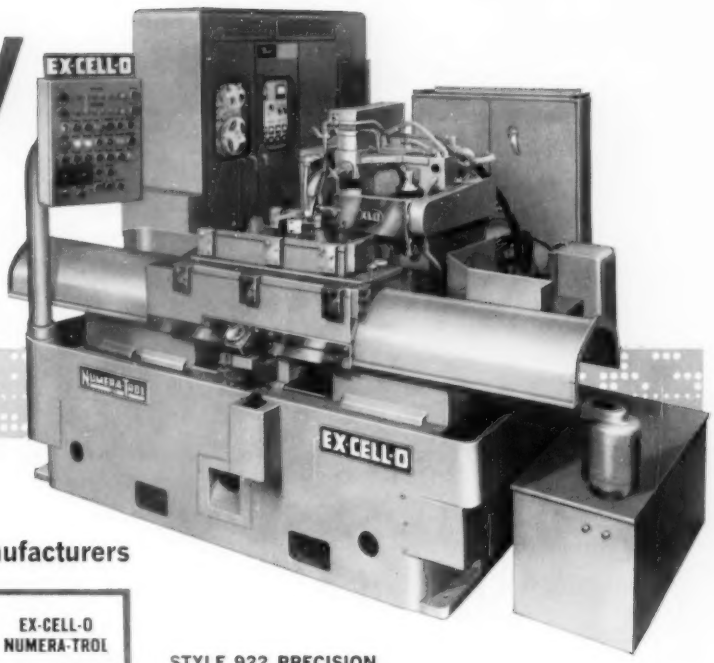

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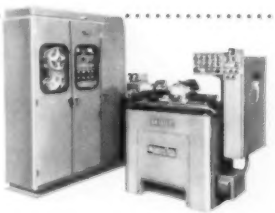

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